Co-funded by the
Erasmus+ Programme
of the European Union

STEM AND GAMES

STEM and Gaming Aims for a Meaningful Educational Success

KA220 Strategic Partnership for School Education

2021-1-ES01-KA220-SCH-000031544

A methodological note

This Project has been funded with support from the European Commission.

This Guide aims to represent the intersection, rather tan the sum of different experiences, what they have in common (trends, causes, contexts, policies, practices, posible solutions), as well as at highlighting interesting and original solutions, which have proved successfully and which might be easily be employed in other countries.

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STEM AND GAMING AIMS
FOR A MEANINGFUL EDUCATIONAL SUCCESS

GUIDEBOOK
FOR TEACHERS
AND TRAINERS

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01 How the Guide can be used in the teaching process

1-PRESENTATION OF THE GUIDE.

Reducing school dropout rates is one of the great challenges facing education in 21st century Europe, in line with the challenges facing the world's population in this century. In this regard, the 2030 Agenda for Sustainable Development, in its goals focused on education, indicates the need to solve the problem of school failure and dropout. It is specifically SDG 4 that advocates for quality education, which is specified as "ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all"; likewise, 4.1 is even more specific, and points to the need to "ensure that all girls and boys complete primary and secondary education".

Faced with the seriousness of such a problem and the need to achieve a high level of achievement and completion of the stages of compulsory education, this guide sets out the different measures proposed in European countries with the aim of tackling problems such as early school leaving. One of the measures shared by the different European countries is the flexibilisation of the curriculum, which allows it to be adapted to the specific educational needs of pupils according to the context in which their teaching and learning process takes place. This measure seeks to make the curriculum more orientative than normative, and to give teachers the freedom and responsibility to determine and specify the knowledge, skills and attitudes of their students. In this sense, the determination of the most favourable methodologies and their application is one of the main objectives to be achieved with this guide.

The section devoted to the different education systems examines in depth those elements which define them, and places special emphasis on the organisational and curricular aspects which seek to combat truancy and its consequences. Thus, the guidelines of each of the systems are presented, which tend to share their competitive nature and the support of the main measures that seek to reduce the figures of school failure. Thus, this section describes the way in which the different educational stages are structured in each country, highlighting those characteristics that contribute to the fight against early school leaving. Special relevance is given to those focused on the stages of secondary education, the area in which the teachers in this project work; specifically, the measures designed to favour the inclusion and success of students in the compulsory educational stages, and the different possibilities offered by each of the educational systems studied to favour the permanence of students in the educational system and achieve success at school are examined in depth. All of them show the educational interest in improving school drop-out rates, and they tend to share curricular flexibility and inclusiveness as the cornerstones of their operating dynamics.

The importance of the fight against school failure is the initial basis of the purpose of this guide; therefore, it presents a chapter dedicated to the conceptualisation and relationships between the terms *early school leaving*, *school failure* and *truancy*, indicators that allow to establish both their causes and the consequences of the actions to combat them. The connection that is repeatedly established between absenteeism, failure and dropping out of school is relevant, so that the result of the study presented is the importance of establishing measures in schools to reduce absenteeism, as it is the gateway to subsequent school failure. Furthermore, this guide describes the secondary school stage as fundamental in relation to early school leaving, as it is the stage in which it emerges in a decisive way, both due to the establishment of a more continuous and stable absenteeism than in primary school, and due to the existence of a first educational qualification that objectively shows the data on pupils who have not been able to obtain the qualification.

Likewise, the analysis of the data analysed in the guide reveals the importance of social vulnerability as a determining factor in school dropout and subsequent failure. Thus, this guide explores this problem in depth in order to find out how these social inequalities can be compensated, a role in which the education sector must play a decisive role. On the other hand, the comparison of data and concepts at European level provided in this chapter gives a broader and more significant picture of the problem of early school leaving in the European countries analysed. The guide presents and studies the most significant data obtained from different sources, from the most general or global to the most local or particular to each school participating in the guide. Despite the fact that the situation of early school leaving differs in each of the participating countries, all of them conclude that there is a need to deepen the decisions that will help to set ambitious targets for improvement in this respect.

In view of the problems described above, this guide proposes the development of innovative and alternative teaching methodologies as a means of correcting the aforementioned school failure figures. With this objective in mind, different SWOT analyses have been carried out in each of the countries that make up the project, aimed at establishing the starting points of each centre in relation to the implementation of active methodologies; in this way, the main strengths and weaknesses of the teaching staff are presented in relation to their vision of the teaching methodologies used in the centre. In addition, these analyses also identify the opportunities and threats that each of the participating schools identify as influencing the implementation of their didactic innovation projects.

Based on the results of these analyses, and as a proposal to solve this problem, the need arises to renew teaching-learning methodologies in educational centres. To this end, in the fourth chapter of this guide, gamification projects are proposed as suitable means to reverse the situation of school dropout and reduce school failure at the centre. The growing importance of gamification methodologies at European level is highlighted here, with a presentation of the most outstanding proposals carried out in recent years. In addition, this guide presents the specific process being carried out by the participating schools to move towards more dynamic methodologies at school level, with gamification at the heart of their actions. It also shows in detail how a gamification project can be developed in each of the participating schools. This part of the guide (chapters 5 to 8) explains step by step how the project should be implemented. The motivation, participation and involvement of the teaching staff in the design of the gamification project is important in this aspect. To this end, their opinion should be reflected in the choice of the proposed topics and in the way the project is developed. Likewise, student participation in the project through the choice of subject matter demonstrates the need for the involvement of the whole educational sector for the success of the project. This degree of motivation must be maintained in both the development and implementation phases of the gamification process, parts of which are described in detail in the guide. Thus, the gamification model, as an active and motivating methodology model, is a necessary tool to reduce absenteeism and school failure figures at the school. Its implementation aims to break the dynamics of student absenteeism that generate school failure and dropout. The motivation of the pupils that characterises it is the central element that should serve to encourage the pupils who are most reluctant to attend classes continuously to wish to participate in a project that interests them, that makes them belong diligently to their educational community and that generates motivation for them to form part of it. Moreover, the flexibility offered by the gamification methodology in its design and implementation is in line with the guidelines of the current educational legislation, which is why it fits in perfectly with the general intentions of this guide: educational improvement through competence development within the framework of a flexible system that is adaptable to the context and interests of the educational community of a given centre.

On the other hand, and in parallel to the description of gamification, this guide presents another innovative methodology as a means to solve the problem of school failure. In this case, it is the STEM methodology, which tries to cover the scientific field from a multidisciplinary perspective. This methodology stands out for its emphasis on the development of students' creativity, through the resolution of contextualised problems that students must face through cooperative work and collaboration among group members. This contextualised work approach enables the development of critical thinking among students, who must carry out reflective work in order to achieve the objectives proposed. The guide presents the situation of this model in the different participating countries, and offers an alternative to offer a methodology based on the specific interests of the students and on the grouping of teaching strategies and the contents of each of the traditional scientific subjects (Mathematics, Technology, Biology, etc.). This interdisciplinary grouping of science subjects aims to motivate pupils in these areas through a didactic approach based on the digitisation of the classroom (in line with the digitisation of society); likewise, its more competence-based and pragmatic approach seeks to create and work around pupils' centres of interest, as explained in each of the analyses presented by the schools participating in this guide.

In short, it is about the presentation of two didactic alternatives that can be applied jointly as they share a common general vision of teaching, curricular flexibility, interdisciplinarity, competence, the use of digitalisation and the motivation of students and teachers as the basis of the centre's project. Activities such as the Escape Room or applications such as Geogebra or Kahoot are some of those used by each of the centres to present their practical contributions in the form of activities in which they base the philosophy of gamification and STEM on specific proposals that try to combine the characteristics of both. The latter finalise the guide presented here and attempt to make different and varied practical contributions that materialise the whole theoretical construct that defines the methodologies that are the protagonists of this guide.

In conclusion, the following guide contains, first of all, a detailed description of the organisation and structure of the education systems in Spain, Croatia, Germany, Greece, Italy and Lithuania. This is followed by a characterisation of the concepts of *early school leaving* and *failure*, and a description and analysis of the data on early school leaving and failure in the countries participating in the project. Thirdly, the different SWOT analyses carried out on the strengths and weaknesses of the European schools in this project on the implementation and development of STEM and gamification methodologies are presented. The following sections analyse the way in which teachers can take advantage of gamification and STEM to act on the interests of their students. In addition, it explores how teachers can increase the motivation of their students and inspire and interest them in problem solving and the use of gamification and STEM methodology as a means to do so. Finally, each of the participating schools in this project presents a series of specific proposals with which to design interactive activities and adapt the curriculum to the methodologies involved in the project.

02 Educational System

Before we delve into the Spanish Educational System , we have to comment that a change in educational legislation is currently taking place in Spain. Since the beginning of 2021, the new education law, the LOMLOE (Organic Law for the Modification of the LOE), which, as its acronym indicates, aims to introduce variations and changes to the previous education law, has begun to be implemented. For this reason, the information below is based on the recent legislation, although it should be noted that today it still coexists with current articles of the previous law. For example, during this academic year 22-23 the curricular modifications related to the objectives and contents of the odd courses are in force, but not yet in the even

The Spanish Educational System is defined in the current education law itself, which describes it as "the set of education administrations, education professionals and other public and private agents that carry out regulatory, financing or service provision functions for the exercise of the right to education in Spain, and the holders of this right, as well as the set of relationships, structures, measures and actions that are developed for this purpose" (LOMLOE, article 2 bis).

This system has a structure that combines a hierarchical and egalitarian arrangement at the same time. It is made up of different interrelated stages based on competences that are developed and expanded as pupils progress through their school education and training. It advocates an education based on equal opportunities, which takes the form of measures to avoid discrimination on economic, social or cultural grounds.

Sustainability is another of the key elements of the system, as schools should be an example and a place for the development of environmental care and the promotion of appropriate environmental education.

The education system is conceived as a means of developing students' competences, as well as the place where the democratic values of our society, such as respect for diversity and recognition of culture, among others, are consolidated. The competences approach is one of the most defining features of the system, as it is generally aimed at providing students with the necessary skills to perform adequately in the world of work and in society. From this characteristic arises a new concept, the *learner exit profile* (perfil de salida), which is made up of those key competences that students must master in order to achieve the socio-occupational objective determined by legislation; thus, the development of reflection and critical thinking, the ability to face problems and apply solutions to them or cooperative work among equals are some of the many components that define this profile.

On the other hand, the concept of *learning situations* (situaciones de aprendizaje) also appears as a consequence of the competence-based nature of Spanish education. These are a type of activity in which students can concretely apply the competences developed and show how they progressively define the exit profile.

One of the main characteristics of the Spanish educational system is the search for greater quality, together with offering equal opportunities to students. To this end, this system is based on the *principle of shared effort*, which defends the need for all educational agents to be committed to the education of pupils: families, schools, teachers and administrations.

Currently, the LOMLOE seeks to adapt educational legislation to the needs of today's society. To this end, it emphasises the defence of children's rights, promotes co-education and inclusion and seeks to implement a more personalised system adapted to the individual needs of pupils. The system also promotes the strengthening of digital competence.

This law also emphasises the concept of lifelong learning, which goes beyond the system itself and extends throughout life. Article 5 of the LOMLOE defines the concept of *lifelong learning*, whereby citizens must have the possibility of training both outside and within the education system, and the State must have the capacity to learn the new labour and social skills required in order to update its educational and training offer. It also promotes the student's own effort, but also his or her capacity to share efforts for the benefit of the collective. It also encourages research and the search for innovative methodologies that favour the educational community.

The educational system defends the role of families in education. It highlights their right to receive free education and allows them to participate in educational decision-making bodies. Furthermore, it is a system of solidarity between the different educational administrations; the LOMLOE establishes the basic educational guidelines, which are set out by the Autonomous Communities in the different decrees published.

Finally, among the most important aims of education in Spain is education in civic and democratic values, in the virtues of our society such as freedom and tolerance and respect for others. Also important in Spain is the defence of the country's linguistic plurality and appreciation of cultural diversity. In short, the Educational System, through the law that governs it, seeks to educate full and free citizens who are aware of and guarantee the democratic values that characterise Spanish society.

THE INSTRUMENT FOR THE ACHIEVEMENT OF EDUCATIONAL OBJECTIVES: THE CURRICULUM

The curriculum is "the set of objectives, competences, contents, teaching methods and assessment criteria for each of the courses" (LOMLOE, article 6). It serves to facilitate the overall objectives of students' citizenship education, as well as to eliminate the obstacles they may encounter in their educational trajectory. The curriculum specification depends on different educational administrations and bodies, which, depending on their competences, specify the different curricular elements mentioned. Thus, from the Ministry of Education to each of the educational centres, they all make their contributions to the curriculum in order to enrich and specify it. Likewise, it is the obligation of the same educational administrations to permanently update the curriculum on the basis of the needs and social changes that are perceived, as well as new claims of competences by the socio-labour entities.

THE SPANISH EDUCATIONAL SYSTEM: STRUCTURE

The structure of the Spanish educational system is organised into different types of education, which are divided into courses, stages and grades. The existing education systems are as follows: Infant Education, Primary Education, Compulsory Secondary Education, Non.compulsory Secondary Education (Baccalaureate), Vocational Training, Language Education, Artistic Education, Sports Education, Adult Education and University Education.

The first stage of education in the Spanish system is pre-school education, where children from zero to six years are attended. Attendance is voluntary, and its main objective is to favour the different levels (emotional, physical, socialising, etc.) of the children who attend the centres. Two cycles are distinguished in this initial educational level, from zero to three years old and from three to six years old. The work with pupils in both cycles is characterised by working in an environment that favours the children's confidence and emotional growth through learning situations in which play is the protagonist. Two fundamental differences should be highlighted between the cycles that make up this stage: on the one hand, the second cycle is free of charge for families; on the other hand, it is in this second cycle that the study and learning of a foreign language is incorporated. The activities carried out at this stage must be experiential and based on the children's interests. This stage is the beginning of much of the learning that will continue in later cycles: numerical experiences, first forays into information technology, experimentation with music and plastic arts, etc.

The current Spanish education system differentiates between basic education, which comprises primary education, secondary education and basic training cycles. This type of education is compulsory and free of charge, and takes place over ten school years, usually between the ages of six and sixteen (there is even the possibility of extending it to eighteen). One of the fundamental pillars of basic education is inclusion, which must be incorporated into all organisational and/or curricular decisions. It is in this phase of education that the objectives based on the formation of pupils' personalities and their ability to function in society are concentrated, so that the competences that revolve around these objectives are developed here, with the aim of enabling pupils to function in everyday social situations.

Primary education is organised in cycles. Specifically, there are three two-year cycles in which the general and main objective is the development of pupils' competences. At the end of each cycle, a report on pupils' competences must be drawn up, accompanied by the necessary measures that each pupil must receive in order to continue his or her educational process in subsequent years. There is also the possibility that certain pupils may continue in the same course for another year on an extraordinary basis if this is considered necessary, provided that a reinforcement plan is established for them to enable them to overcome the difficulties detected.

At this stage, objectives such as the gradual consolidation of work habits, the acquisition of conflict resolution skills, knowledge of basic mathematical and linguistic skills, the learning of technological tools and their critical evaluation, or the fundamental notions of social and natural science knowledge are proposed.

The existing areas are the following: Knowledge of the natural, social and cultural Environment (where Social Sciences and Nature Sciences can be differentiated), Artistic Education (where Plastic and Visual Education can be found, and, on the other hand, Music and Dance), Physical Education, Spanish Language and Literature, Valencian Language and Literature, Foreign Language and Mathematics. In addition, in the third cycle, the subject Education in Civic and Ethical Values must be studied.

Inclusive idiosyncrasy is the axis of this stage, and to favour it, alternatives such as methodological innovation or the achievement of learning adapted to the difficulties of pupils and favouring the overcoming of these difficulties are proposed. The education law itself states that reading and writing comprehension and expression, digital competence, the promotion of creativity, and education for peace and sustainability, among many others, are the basis of this educational stage. Another characteristic at this stage is the presence of globalising and comprehensive projects that promote pupils' abilities such as autonomy and competence in solving everyday problems.

In secondary education, a distinction is made between the compulsory and post-compulsory stages; the latter includes the baccalaureate, intermediate vocational training, professional artistic education in music, dance and design, and intermediate sports education.

In Secondary Education, emphasis is placed on the achievement of objectives based on the apprehension of culture, both in its humanistic and technological and scientific aspects. It is a stage in which daily work and study habits are strengthened, in order to be able to enter the world of work and life as a full citizen. The promotion of individual autonomy and the development of a critical spirit are other key elements of this stage of education. Likewise, and as in the previous stage, personalised attention and the inclusive nature of education continue to be descriptors of this educational period.

The following subjects must be studied between the first and third courses of Compulsory Secondary Education: Biology and Geology, Physical Education, Plastic, Visual and Audiovisual Education, Physics and Chemistry, Geography and History, Spanish Language and Literature, Valencian Language and Literature, Foreign Language, Mathematics, Music and Technology and Digitalisation. It is also possible to take a second foreign language. Alongside these, an optional subject will be offered in each year, with the possibility of it being structured in the form of an interdisciplinary project. Likewise, Classical Culture and Digital Competence must be offered as compulsory optional subjects, together with the second foreign language indicated. The Autonomous Communities can specify some subjects in the curriculum; specifically, the Valencian Community proposes some different subjects specific to our territory: Reinforcement Workshops, Deepening Workshops, Oral Communicative Competence in a Foreign Language, Musical Creativity, Social and Sustainable Entrepreneurship or Programming, Artificial Intelligence and Robotics, among others.

The option of organising the above subjects into learning area groups is offered, with the aim (especially in the first year of secondary education) of facilitating the change and transition of pupils from one stage to another. For this reason, it is not acceptable for pupils in the first and second year of secondary education to study two or more subjects than those studied in the sixth year of primary education. This grouping of subjects is also intended to increase pupil motivation and improve coordination between teachers in these years.

One of the aims of the final year of Secondary Education is to guide pupils towards further studies. To this end, students and their legal guardians are given a report on the level of acquisition of competences achieved, as well as a recommendation on the most appropriate option for continuing their studies.

This course has a different distribution of subjects from the previous three ones. In this case, they are Physical Education, Geography and History, Spanish Language and Literature, Valencian Language and Literature, Foreign Language and Mathematics (of two different types). Likewise, in the Valencian Community, several optional subjects are offered, from which students must choose three: Biology and Geology, Digitalisation, Economics and Entrepreneurship, Artistic Expression, Physics and Chemistry, Personal Training and Orientation, Latin, Music, Second Foreign Language and Technology.

Alongside these, there is a group of optional subjects, of which the pupil takes one: Performing Arts, Oral Communication Skills, Philosophy, Interdisciplinary Projects, Deepening Workshop and Reinforcement Workshop.

The education law highlights for this stage some transversal knowledge that must be present in the various subjects indicated; this is the case of communication skills (mainly reading and writing, but also related to audiovisual media), initiative in the field of business and economics, a reflective and critical view of reality, the importance of emotions and values in society, the defence of gender equality or innovation in the field of creation and generation of content. Likewise, and as already emphasised in primary education, pre-eminence is given in all areas to health education, appreciation of culture, art and heritage, environmental education and the cooperative spirit that should govern human activities.

In order to help pupils with greater difficulties to achieve the competences of the stage, there are curricular diversification programmes. These, from the third year onwards, allow these pupils to improve their abilities and enable them to obtain the Diploma in Secondary Education. Students who are not able to successfully pass the second year are admitted to these programmes, following a proposal from the teaching team and with the family's approval. It is also possible to integrate students into the fourth year of these programmes if they meet the aforementioned conditions. These are mainly structured in three areas: Linguistic and Social Area (with the basic knowledge of Language and Literature and Geography and History), Scientific Area (with Mathematics, Biology and Geology and Physics and Chemistry) and Practical Area (which encompasses the knowledge of Technology, Digitalisation and Personal and Professional Training and Guidance). These are, together with Physical Education, Education in Civic and Ethical Values and an optional subject, the subjects that make up the Curricular Diversification Programmes.

Another of the possibilities offered by the Spanish education system for students who do not manage to adequately develop the necessary competences is the basic level training cycle. In this cycle, students try to achieve the proposed competences by means of studies oriented towards certain professional modules (computer science, electricity, gardening, among many others).

Access to these studies requires the prior fulfilment of certain conditions on the part of the students. They must be fifteen years old (or turn fifteen during the course) and have completed the third year of compulsory secondary education (or at least the second year); in addition, the family or legal guardians of the pupil must authorise their entry into this cycle.

The role of guidance and tutoring, as well as the adaptation and personalisation of the curriculum, is noteworthy in these courses. It is a mainly practical and applied cycle whose development is promoted in conjunction with local business, associative or commercial entities. At the end of the cycle, the student obtains the title of Graduate in Secondary Education, as well as the title of Basic Technician in the professional family worked on.

This cycle is structured in learning areas. Firstly, one of Communication and Social Sciences, which includes the subjects of Spanish Language, Valencian Language, Foreign Language and Social Sciences; secondly, one of Applied Sciences, with Applied

Mathematics and Applied Sciences; and thirdly, a Vocational Area, focused on the teaching necessary to achieve the professional qualification of the cycle.

A third option for students with learning difficulties and disruptive behaviour is the Shared Classroom Programme (PAC). The main objective of this programme is to reduce school drop-out rates and to find academic options for pupils who are more likely to be socially marginalised. In this programme we work in a personalised way with the pupils so that they acquire the most basic skills, in collaboration with social entities that allow them a first approach to the world of work and integration into social life. PAC students must be between fourteen and sixteen years old and have a high probability of not continuing in the education system for social reasons. At the end of the programme, they can go on to a basic training cycle or enter the world of work. It is organised in the form of areas. On the one hand, the academic area covers all the subjects of the student's course, with special attention to their practical nature; on the other hand, the workshop classroom area allows them to train in professional activities in work areas outside the centre (associations, institutions, etc.).

Assessment in secondary education is "continuous, formative and integrative" (LOMLOE, Article 28). The promotion of pupils is decided by the teaching team on the basis of the competences and objectives achieved by the pupils. In any case, students who have been assessed negatively in one or two subjects are promoted to the next year, while if they have been assessed negatively in three or more subjects, the teaching team will assess the possibility of achieving the objectives of subsequent years despite the failure to pass certain subjects. In the case of promotion with negatively assessed subjects, the teaching team designs *reinforcement plans* so that the students can pass the subjects of previous years during the current academic year. It is considered extraordinary for a student to remain in the same year for two consecutive school years, and he/she can only do so once in the same year and twice throughout the whole stage. In the event that this happens, the teaching team must develop the appropriate measures so that students in this situation can overcome their difficulties and achieve the objectives and competences set through a *specific personalised plan*. It is also possible for pupils to remain in the same year for a longer period than that established in the regulations, provided that the teaching team determines that this measure favours the pupil's chances of obtaining the Secondary Education Graduate qualification. It is also possible to obtain this qualification by passing extraordinary tests in the not passed areas. In no case does the adoption of specific measures for students with special educational needs prevent them from obtaining the qualification, although these measures must be identified together with the qualification. In the event that the qualification is not obtained, the pupil obtains a certificate indicating the number of years studied and the competences acquired during these years.

The Secondary Education Graduate qualification provides the possibility of continuing studies at Baccalaureate and intermediate vocational training level, or of entering the world of work. In addition, after passing a specific test, it is also possible to study plastic arts and design, or intermediate level sports education.

Baccalaureate studies consist of two years, and represent the continuity of the competence condition of the Spanish education system. Autonomy in learning, cooperation in daily work and the beginning of research work are some of the features that define this post-compulsory stage.

The baccalaureate is divided into four modalities: Science and Technology, Humanities and Social Sciences, Arts and General. Each of these includes, in any case, the following subjects: Physical Education, Philosophy, Spanish Language and Literature, Valencian Language and Literature, History of Philosophy, History of Spain and Foreign Language. In addition, optional subjects specific to each modality, to be specified by the relevant autonomous administration, must be taught.

In terms of assessment, the defining features are continuous and competency-based. At this stage, there is a special exam to pass subjects that have been assessed negatively in the first year of the baccalaureate. It is also possible to move on to the second year of Baccalaureate with two subjects not passed in the first year. The Baccalaureate Diploma is obtained through the positive evaluation of the subjects of the two courses, although it is also permissible to obtain it if one of these subjects has not been passed; in this case, the student must have attended regularly and have generally achieved the competences required at this stage. This qualification can also be obtained from the Technical Diploma in Vocational Training or in Plastic Arts, as well as for graduates in Music and Dance, after having passed certain subjects of the Baccalaureate.

The transition to university studies requires the completion and passing of an entrance exam that serves to show the student's competencies and their ability to satisfactorily complete university courses. This test can be taken by any student with the Baccalaureate Diploma, has general characteristics common to all of Spain and its results are considered valid for access to any Spanish public university. This exam is divided into two phases: on the one hand, the compulsory phase (in which students are examined in a group of common subjects), and on the other, the voluntary phase (in which they are examined in certain optional subjects). In order to pass the entrance examination, the mark obtained in the compulsory phase must be at least 5. The university entrance mark is the result of the weighting between the average mark obtained in the Baccalaureate studies (60 %) and the mark obtained in the compulsory phase (40 %). This mark may be improved by the marks obtained in the voluntary phase, the results of which may be multiplied by 0.1 or 0.2, depending on their relation to the university studies to which access is sought.

Another alternative in the Spanish education system for students who hold the Diploma on Seconday Education is Vocational Training. The objective of these studies is to train students in a specific profession, to introduce them to the world of work and to initiate them responsibly in social and economic activity. These studies include basic (as mentioned above), intermediate and advanced vocational training courses. In addition, there are related *specialisation courses.* All of them are organised through modules or blocks of different lengths and idiosyncrasies, as some of them focus on more theoretical contents, while others have a more practical purpose. The different qualifications grouped according to certain professional families are validated in the so-called *National Catalogue of Professional Qualifications*. This catalogue can be modified and extended according to the needs and demands of the different Spanish socio-economic sectors.

Students who have obtained the Secondary Education Graduate qualification may enrol in Intermediate Level Training Cycles. It is also possible to access by passing a specific test organised by the educational administrations (in this case the student must be seventeen years old, or do so during this course), or by holding a Basic Technical Diploma.

In the case of higher level training cycles, access is by means of the Baccalaureate qualification, the passing of a specific test organised by the educational administrations (in this case the student must be nineteen years old, or do so during this course), or with the possession of a Higher Technical or Intermediate Level Vocational Training qualification.

The structure of these two cycles is modular, and in any case includes a stay in work centres for the practical part, which can be carried out in dual form. Each cycle is organised in two years, but students can study them in up to four years. These periods can also be modified in the case of students with special educational needs, who receive a flexible and inclusive response to their abilities.

In any case, vocational training studies should focus on providing students with the digital skills demanded by today's society, as well as those of an entrepreneurial and innovative nature that will enable them to undertake and direct their professional careers. Likewise, the management of the risks inherent to their professional activities, environmental awareness or the assumption of commitments in this type of activities should be other interdisciplinary axes that guide this stage.

In order to obtain the corresponding qualifications of the intermediate and higher cycles, it is compulsory to pass all the existing modules. Once they have been passed, the Technical Degree is obtained (in the case of the intermediate level) or the Higher Technical Degree (for the higher level). With this last qualification it is possible to access university studies through a certain admission process.

Professional Music or Dance Education is another of the alternatives offered by the Spanish education system to its students. Successful completion of intermediate level studies in these fields leads to a technical qualification and a Baccalaureate Degree in the artistic modality, while a positive evaluation in higher level studies is equivalent to a university degree.

There are also sports education courses, which can be accessed with a Secondary Education Graduate (in the case of intermediate level courses), or with a Baccalaureate or Higher Technician (for higher level courses).

Finally, within the Spanish education system, it is worth highlighting the existence of education for adults (who are eighteen years old or will be eighteen during the academic year). Technological supports play an important role in the training of these people, a basic tool to meet the individualised needs and pace of students who are often already immersed in the world of work. Learning in this education is aimed at obtaining the Secondary Education Graduate Diploma, for which specific tests are organised to enable this to be achieved.

The last level of the Spanish education system is university studies. These are organised on the basis of the European Higher Education Area and are structured in three cycles: Bachelor's, Master's and Doctorate. Access to the Bachelor's Degree is through the Baccalaureate or Higher Technical Degree; the Bachelor's Degree consists of a number of credits of between 180 and 240 credits (each one equivalent to 10 hours of teaching) and culminates with the preparation of a Final Project. The Bachelor's degree gives access to Master's studies, higher degrees of between 60 and 120 credits that allow graduates to specialise. The third cycle of these studies is the Doctorate, which focuses on research in the student's area of study. These studies end with the public presentation of an unpublished research work.

THE EVALUATION OF THE EDUCATIONAL SYSTEM

As it has been pointed out throughout the description of the system, the Spanish Educational System must be subject to a general assessment of the competences attained by pupils. The National Institute for Quality Education is responsible for organising and specifying this assessment in coordination with the educational administrations. Thus, it is in the final years of primary and secondary education that this assessment must be carried out, with the aim of identifying the weaknesses and strengths of the system. Diagnostic tests should also be carried out in the fourth year of primary and second year of secondary education, where students' linguistic and mathematical abilities are tested.

Moreover, the teaching task must also be evaluated. The education administration proposes different means of teacher evaluation and self-evaluation, and should encourage the participation of teachers in these procedures.

THE ORGANISATION OF EDUCATIONAL ESTABLISHMENTS

The LOMLOE describes the capacity of schools to autonomously take specific measures that lead to improvements and progress in education. In doing so, it encourages concrete decision-making based on the context in which the daily life of each school takes place.

The guide for pedagogical action in schools is the school's educational project. It integrates the curricular specifications indicated by the educational administrations, while specifying the treatment of the values and competences that will be worked on at the centre. This document is based on the characteristics of the educational context in which the centre is located, and from this it sets out the didactic and pedagogical strategies to be carried out, with special emphasis on the way in which the diversity and educational needs of the students are dealt with. Within this project there must be an *improvement plan* which reviews the degree of achievement of the proposed objectives and the measures to increase this degree.

The School Council is the body in which families, pupils, teachers and non-teaching staff participate in schools. It has a proactive and dispositive nature, as it has the capacity to generate educational proposals and develop them in order to improve the quality of education. This body is responsible for approving general programming, school projects and the school budget. It also applies disciplinary measures and promotes initiatives to improve the school's infrastructure.

On the other hand, the management team is responsible for the administration of resources and organisation, and also exercises pedagogical leadership in the school. Each team is made up of at least one principal, one head of studies and one secretary. It is the first of these who represents the school before the educational administration, who directs institutional and teaching activity, develops the school's relations with families, promotes the different types of assessment, leads methodological and innovative initiatives and is responsible for the school's budgetary control.

The work of school management is supervised by the educational inspectorate. The inspector reviews the operation of the school, both pedagogically and organisationally. He/she assists the management team, resolves doubts about legislative issues, supervises compliance with regulations, proposes measures for conflict resolution, etc.

A third organisational sector in schools is the teaching staff. It is made up of the entire teaching staff, and through it decisions are taken that affect the day-to-day educational development of the school. It is also responsible for analysing the results of the different types of evaluation applied to improve the teaching task.

Finally, within the organisation of schools, and at a more specific structural level, there are the teaching co-ordination bodies. These are grouped according to their purpose (improvement of certain areas, or around various issues: coexistence, innovation, etc.) and, in secondary schools, they usually correspond to the so-called *teaching departments*.

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2.2 Croatia

The education system in the Republic of Croatia can be divided as follows: early and preschool, elementary, secondary, adult education and higher education.

Early and preschool education

Early and preschool education of children takes place in kindergartens, which can be public or private, it is not compulsory and it is paid for. Kindergartens usually work from Monday to Friday, from 8 a.m. to 4 p.m., with on-call hours until 6 p.m. They are organized into groups where there are about 20 children in public and about 10 children in private kindergartens. The prices of public kindergartens range between 200 and 350 euros. Part of this amount (100 euros) is paid by the parent, and the rest is subsidized by the city or municipality. The prices of private kindergartens are around 200 euros for parents, while the rest is subsidized by the city or municipality. In kindergartens, children are offered programs of upbringing, education, health care, nutrition and social care. Education in kindergartens is divided into two educational cycles:

A. nursery: from 6 months to 3 years of age;
B. kindergarten.: from age of 3 until starting school (age 7).

Special programs in early and preschool education

a) Preschool program - is mandatory and intended for children before starting school for a year (October 1 - May 31). It is paid monthly according to the valid price list of the municipality or city.

b) Montessori program - certain kindergartens offer this special program. The program is paid in addition to the regular program.

c) Special program for children with disabilities - kindergartens offer this program without paying an additional fee.

Elementary education

Elementary education (ages 7-15) in the Republic of Croatia takes place in elementary schools, which can be public or private, it is free and compulsory, and lasts 8 years. Education in primary schools is divided into:

A. classroom teaching (1st-4th grade)
B. subject teaching (5th-8th grade).

Classes are held in two programs: regular and special. Special programs are intended for students with disabilities, and their education can last up to the age of 21. For everyone over the age of 15 who has not completed the legally required elementary school, there is adult education.

Enrollment in primary school

Upon completion of preschool education, children undergo a medical examination and an interview with the expert committee at the school they wish to attend (depending on the place of residence), no later than June 15 of the current year.

In certain situations, early enrollment of a child in the 1st grade , as well as a postponement for the next school year., in case of reduced emotional or physical ability of the child, is possible

Organization of class and subject teaching

Class teaching can be conducted in one shift or one shift with an extended stay. Extended stay is intended for children whose parents are unable to leave the child alone at home (8 am - 4 pm).

Subject classes can be conducted in one, two or even three shifts, depending on the schools' capabilities. Most often there are two shifts: 8 am - 2 pm or 2 pm - 8 pm.

Duration of the school and teaching year

The school year lasts from September 1 to August 31, and the academic year from the first Monday in September to June 21. There are five holidays during the school year:

a) autumn (end of October/beginning of November) - 2-3 days
b) winter (end of December/beginning of January) - 14 days
c) winter second part (end of February) - 5 days
d) spring (end of March/beginning of April) - 5 days
e) summer (end of June - beginning of September) - 10 weeks

High school upbringing and education

Secondary education (ages 15-18), which is optional, takes place in secondary schools and student dormitories. Secondary schools can be public or private . The teaching process in secondary schools can be carried out in one or two shifts, depending on the possibilities of the schools. Most often there are two shifts: 8 am - 2 pm or 2 pm - 8 pm. The programs that are carried out in secondary schools are:

A. programs for obtaining a lower level of secondary education;
B. programs for acquiring secondary education;
C. training and development programs.

Secondary schools are divided into gymnasiums, vocational and art schools.

Enrollment in high school

Enrollment in secondary school is carried out electronically on the website www.upisi.hr. Students can choose 6 different programs, change them and follow the rankings until a certain date when the lists are locked. After that, changes are no longer possible.

In secondary schools, students can be educated according to an individualized program without or with adaptation of content, while students with greater difficulties can be educated in special educational institutions adapted to their needs. Students with disabilities have the right to enroll directly in a specific program, with the maximum number of students with disabilities per class being limited to 3.

Duration of the school and teaching year

The school year lasts from September 1 to August 31, and the academic year from the first Monday in September to June 21. There are five holidays during the school year:

a) autumn (end of October/beginning of November) - 2-3 days
b) winter (end of December/beginning of January) - 14 days
c) winter second part (end of February) - 5 days
d) spring (end of March/beginning of April) - 5 days
e) summer (end of June - beginning of September) - 10 weeks

Gymnasium

Gymnasiums are general education schools lasting four years, and students finish them by taking the final state exam. In addition to regular subjects, high school offers optional subjects and optional classes, as well as numerous extracurricular activities. In high school programs, students can learn two or three foreign languages, as well as Latin (grades 1 and 2). There are five types of high school programs:

a) Gymnasium with general subjects;
   a1) sports gymnasium;
   a2) bilingual program of general high school;
b) Gymnasium with more hours in languages;
c) Gymnasium with more hours in classic languages (Latin and Greek);
d) Gymnasium with more hours in science and mathematics;
e) Gymnasium with more hours in science;
f) vocational Gymnasium - experimental program.

Vocational schools

Vocational education in the Republic of Croatia is extremely broad, and therefore important and essential. Vocational education lasts from one to five years. After finishing school, students can join the labor market or, subject to certain conditions, continue with secondary or higher education. By completing a three-, four-, or five-year vocational school, students obtain a secondary level of education, while those who complete a two-year education obtain a lower level of secondary education.
Vocational education is divided into 14 sectors:

1. Economics, trade and business administration
2. Electrical engineering and computing
3. Geology, mining, oil and chemical technology
4. Construction and geodesy
5. Graphic processing and audiovisual design
6. Personal, protection services and other services
7. Agriculture, nutrition and veterinary medicine
8. Traffic and logistics
9. Mechanical engineering, shipbuilding and metallurgy
10. Forestry, processing and processing of wood
11. Textiles and leather
12. Tourism and catering
13. Art
14. Health and social care

It is interesting to note that in the 2014-2015 school year over 65% of students enrolled in one of the professional sectors mentioned above. But it is also a fact that some of the above-mentioned sectors have not been enrolling the required quota of students for years. Students are additionally motivated with various scholarships and incentives.

Curriculum in gymnasiums

a) Gymnasium with general subjects

Subject	Number of hours per week			
	1.r	2.r	3.r	4.r
Croatian language	4	4	4	4
Foreign language I	3	3	3	3
Foreign language II	2	2	2	2
Latin language	2	2	-	-
Music art	1	1	1	1
Art	1	1	1	1
Psychology	-	1	1	-
Logic	-	-	1	-
Sociology	-	-	2	-
Philosophy	-	-	-	2
Mathematics	4	4	3	3
Physics	2	2	2	2
History	2	2	2	3
Geography	2	2	2	2
Chemistry	2	2	2	2
Biology	2	2	2	2
Informatics	2	-	-	-
Politics and economy	-	-	-	1
Religious Studies/Ethics	1	1	1	1
Physical education and sports	2	2	2	2
Elective course	-	2	2	2
Total hours:	32	33	33	33

a1) sports gymnasium;

This type of gymnasium is intended for students who are actively involved in sports. The curriculum is the same as the general gymnasium curriculum, but classes are organized mainly in the morning shift so that students can successfully complete their sports duties in their clubs.

a2) bilingual program of general high school;

Due to the great interest, but also the needs of students, a certain part of general high schools conduct their programs in the form of a bilingual program. Some of the subjects are taught in Croatian and some in one of the foreign languages: English, German or French. Most often, these are natural-mathematics groups of subjects. Classes are conducted according to the Croatian national curriculum.

b) Gymnasium with more hours in languages;

In the language high school, compared to the general high school, the emphasis is on a greater number of language lessons. Thus, instead of two foreign languages, three are learned. The number of teaching hours in science subjects is lower compared to the teaching hours in general high school.

c) Gymnasium with more hours in classic languages (Latin and Greek);

The curriculum in the classical gymnasium is the same as that in the general gymnasium, except that Greek is taught in addition to Latin.

d) Gymnasium with more hours in science and mathematics;

In the science and mathematics high school, compared to the general high school, the emphasis is on a greater number of lessons in natural (biology, chemistry, physics) and mathematics subjects compared to the teaching hours in the general high school.

e) Gymnasium with more hours in science;

In the science high school, compared to the general high school, the emphasis is on a greater number of hours in natural subjects (biology, chemistry, physics) compared to the teaching hours in the general high school.

Curriculum in vocational schools

The curriculum in vocational schools depends on the sector to which the school belongs. It consists of general educational content as well as a professional part. Part of the program within the curriculum has a mandatory professional practice that students take during the academic year, as well as in the summer period. Completed professional practice is a condition for successful completion of the class.
In addition to regular programs, there is also a unique model of education in which students go to school one week, while the next week they go to practice outside of school, with an employer. These are three-year vocational programs such as hairdressers, beauticians, cooks, waiters, confectioners and others.

Adult education

Adult education is available to all adults in the Republic of Croatia. Participants acquire basic knowledge in order to increase their chances of employment, improve their knowledge, or get a lifelong education.

Art education

In the Republic of Croatia, in addition to primary and secondary education, there is the possibility of art education - elementary and secondary. These can be dance, music and art schools, and children aged seven or nine have the right to enroll. When enrolling, children must meet all enrollment criteria.
Elementary dance school education lasts four years, while primary music school education lasts six years.
In addition to elementary school education, secondary school education is also possible.
Students can attend secondary music school education upon completion of elementary music school or upon completion of preparatory music education for a duration of two years. Also, participants can attend secondary school of music independently (for four years) or in parallel with another secondary school program for four years. If a student attends only secondary music school education, the student finishes secondary school by creating and defending the final thesis. Upon completion, he can take the state final exam.
Secondary dance and art school education is carried out in the same way as secondary music school education.

Completion of the secondary school system

All high school programs end with passing the state matura at the end of the 4th grade, while vocational education programs end with writing and defending the final thesis at the end of the 2nd, 3rd, or 4th grade (depending on the duration of the program). Also, students who complete four-year vocational programs can apply for the state matriculation exam.
The state matura is a unique exam that consists of three mandatory parts: Croatian language, foreign language (English or German) and mathematics, as well as an unlimited number of optional subjects. Exams are taken according to the high school curriculum. The time of the exam is strictly defined by the National Center for External Evaluation, and each exam is conducted on a specific day and at a specific time throughout the Republic of Croatia. There are two exam periods: summer and fall.
Compulsory exams:

a) Croatian language
- one level
- exam consisting of two parts: 1. essay; 2. literature, non-literary text and grammar

b) English/German language
- two levels: A (higher), B (lower)
- exam consisting of three parts: 1. writing; 2. listening; 3. reading

c) Mathematics
- two levels: A (higher), B (lower)

Elective exams may or may not be taken. It depends on the student's preferences and they are always taken at level A (higher) according to the high school curriculum.

A passed matura is considered to be the one when a student passes all three compulsory subjects with the lowest positive grade . If a student does not pass the exams in the summer term or is not satisfied with the grade, they are referred to the autumn term.

Students of high school programs complete their high school education by successfully passing the matriculation exam.

Higher Education

Higher education in the Republic of Croatia takes place at universities, colleges, art academies, polytechnics and colleges. Universities are public, but polytechnics and colleges can be public or private.
Higher education is carried out as university or professional studies.

Enrollment in higher education

Enrollment in higher education (public) is carried out electronically on the website www.postani-student.hr. Students can choose 10 different programs, change them and track the rankings until a certain date when the lists are locked. After that, changes are no longer possible. Certain universities or faculties may, in addition to the state matriculation exam, make it a requirement to take an additional entrance exam.
Enrollment in higher education (private) is carried out by taking an entrance exam or by direct enrollment.

University study and Professional study

University studies take place at universities, and qualify for jobs in science, higher education, business world, public sector and society in general. They take place at three levels:

Name of the Study	Duration	Points (ECTS)	Name of qualification
Undergraduate University Study	three or four years	180 - 240	Bachelor of …
Graduate University Study	one or two years	60 - 120	Master of …
Postgraduate University Study			
1) Postgraduate Specialist Study	one or two years	/	University specialist in …
2) Doctoral Study	minimum three years	/	Doctor of

Upon finishing undergraduate and graduate university studies, the student obtains a minimum of 300 ECTS credits.

Professional study takes place at a university (with a permit), polytechnics and colleges, and it qualifies students for work in applied professions, as well as immediate participation in the workplace. As with university studies, it takes place on three levels:

Name of the Study	Duration	Points (ECTS)	Name of qualification
short professional studies	two or two and a half years	120 - 150	Associate degree of
undergraduate professional studies	three or four years	180 - 240	Bachelor of applied science in…
specialist graduate professional studies	one or two years	60 - 120	Specialist in …

Teaching process in higher education

In higher education, teaching is conducted on a full-time (without payment or with payment) or part-time program.

A student studying under a regular program is obliged to participate in all activities of that program and has all student rights. Student rights that are covered are: subsidized meals in canteens, transportation by public transport, free health insurance, and the possibility of accommodation in student dormitories at a cheaper price. In addition to studying, students can also work through the student service on a contract basis.

A part-time program may include partially mandatory participation in the activities of that program, but there are no student rights. This program is intended primarily for working people.

Duration of the academic year and exam deadlines

The academic year lasts from October 1 to September 30. During the academic year, there are three main exam periods:

a) autumn (September)
b) winter (February)
c) summer (June - July

In each exam period, there are two exam dates, two weeks apart.

Students can take each subject exam 4 times: 3 regular times and 1 before the faculty committee. If the student does not pass the exam, they must re-enroll in the next academic year. If the student does not pass that subject again in the following academic year, they lose the right to study at the enrolled faculty.

Attending the exam is registered three working days before the exam date.

2.3. GERMANY

The Federal Republic of Germany consists of sixteen different individual states. All these states are responsible for their educational system. That means the school system depends on the region where you live. There are different kinds of school systems, different curriculums and different textbooks in every state.
The individual states also have different types of schools. But they have in common that school attendence is compulsory in Germany beginning with primary school at the age of six. Most schools are public schools and they are free for everybody. In addition there are private and international schools which charge fees.

THE STANDING CONFERENCE OF THE MINISTERS OF EDUCATION AND CULTURAL AFFAIRS (KMK)

KULTUSMINISTER
KONFERENZ

Source: https://www.kmk.org/kmk/information-in-english.html

The Standing Conference of the Ministers of Education and Cultural Affairs, the so-called KMK, is a conference of all sixteen Ministers of Education and Cultural Affairs in Germany. It plays a very important role as an instrument for the coordination and development of education in the Federal Republic of Germany. The KMK is a consortium, not only consisting of the sixteen Ministers of Education but also of institutes of higher education and research and cultural affairs. They discuss joint interests of all sixteen federal states. Each federal state has one vote in the Standing Conference of the Ministers of Education and Cultural Affairs.
The KMK was founded after World War II in the year 1948. In this year the Minsters of Education and Cultural Affairs from the three western zones of occupation agreed that the KMK should become a permanent institution. After the reunification of Germany in 1990 the federal states on the territory of the former German Democratic Republic joined the KMK.
One of the main tasks of the KMK is the cooperation between the sixteen federal states to reach the highest achievable level of mobility for learners, students and teachers in the country. They also help to create equal living and learning conditions across Germany.
Each calendar year a Presidium is elected by the plenum. The Presidium appoints a President and three Vice-Presidents. The Presidium prepares important plenary issues. There are also different kinds of committees, e.g.:

1) School Committee and Sub-Committe for Vocational Education and Training and Continuing Education and Training
2) Higher Education Committee and Sub-Committee for Medicine at Institutions of Higher Education
3) Cultural Affairs Committee
4) Federal Government-Federal States Committe for Schools Abroad

There are also Standing Commissions:
1) Chiefs of Staff Commission for Quality Assurance in Schools
2) Chiefs of Staff Commission for Quality Assurance at Institutes of Higher Education
3) Commission for European and International Affairs

4) Commission for Teacher Training
5) Sports Commission
6) Commission for Statistics

The offices for the Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs are in Bonn and Berlin. It is headed by the General Secretary who is a permanent representative. The Secretariat has to plan the meetings held by the Plenum, the Committees and the Commissions.
Part of the Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs is the „Pädagogischer Austauschdienst" (PAD). Its main responsibilty is the international cooperation on behalf of education. One part of it is the Erasmus+ programme.

Pre-school Education

In Germany maternity periods begin six weeks before birth and end eight weeks after birth – so maternity leave is 14 weeks. In that time you get full salary. After that there is parental leave for fourteen months of flexible time. Parental leave can be split between both parents. In that time the parents can get parental allowance, the amount depending on how the parental time is split between the parents. In Germany you also get child allowance from birth until at least their 18th birthday.
In Germany you divide between institutional and non-institutional pre-school childcare.

Non-institutional childcare

Parents who go to work can give their children to a so-called „Tagesmutter". A „Tagesmutter" or „Tagesvater" is a female/ male nanny who cares for a small number of children in her/ his own home. It is among the most popular forms of non-institutional care for children under the age of three. A „Tagesmutter" or „Tagesvater" must have permission by the local Youth Welfare Office. In case they don´t have any social-pedagogical education they need to do a childcare training. The courses last at least 160 hours. Mostly this form of childcare is used for children between the age of one and three.

Institutional childcare

Institutional pre-school childcare is provided by the Kindertagesstätte (Kita) or the Kindergarten. Children under the age of three go to the Kita. Parents can bring their children in the early morning and pick them up in the evening. Sometimes children under the age of three are in toddler groups but sometimes they are also in groups mixed with older children. There is only one day-care facility designed for children under the age of three: the Kinderkrippe. A Kindergarten mostly accepts children between three and six years.
In March 2022 there were in Germany 59.323 Kitas. More than 3.2 million children attend them. More than the half of them visit a Kita seven hours a day or more.
Institutional childcare is provided by social-pedagogical staff. There are several levels of social-pedagocical education:
1) Kinderpfleger/in: It´s a social-pedagocical assistant and you can do an apprenticeship for it in special kinds of vocational schools. The training lasts for two years and during the training you have to do internships in day-care facilities, youth facilities or children´s hospitals.
2) Erzieher/in: 70% of staff in institutional pre-school childcare has this level of education. A „Erzieher/in" has to do two to three years at a special academy and additionally one year of internship in different childcare

facilities.
3) Sozialpädagoge/Sozialpädagogin: It´s a certified profession. They have to study at least three years for that kind
of profession. Additionally they have to do internships.
4) Kindheitspädagoge/ Kindheitspädagogin: They also have to study childhood education (three to five years).
5) Heilerziehungspfleger/in: these are special needs educators. They have to attend a special kind of school for
two years and then there follows a practical year. Heilerziehungspfleger/innen take care for children with
physical, mental or emotional disabilities.

PRIMARY SCHOOLS

School attendence is compulsory in Germany beginning with primary school at the age of six, homeschooling is illegal in Germany. You can get fined or even get imprisonment if you don´t enroll your child in a school.
Normally, primary school covers the first four grades. Only in Berlin and Brandenburg does primary school continue up to grade six.
In Germany parents can choose between state or private primary schools. Most of the children attend a state primary school. In the school year 2021/22 were 15.466 primary schools in Germany. The vast majority of it were state schools. State primary school are free to attend in Germany. There are also state-subsidized private schools, like religious and alternative schools which charge fees.
According to the INSM-Bildungsmonitor 2022, which evaluates the education system in each federal state of Germany, the top-performing states are Sachsen, Bayern and Thüringen. The lowest-performing states are Bremen, Brandenburg and Sachsen-Anhalt.
State primary schools generally teach 20 to 30 hours a week. The school day normally starts around 8 am and finishes around 1 pm. In the afternoon they often provide childcare, including lunch, afternoon clubs, sports activities and homework workshops. Parents may have to pay fees for that but those on low incomes may get state subsidies. Some so-called „Ganztagsschulen“ also have lessons in the afternoon. Subjects taught can vary but they generally include German, Mathematics, Art, Physical Education, Music, Religious Education and Social Sciences like history and geography.
A school year starts from mid-August or early September to the end of June or July. All federal states have their own number or time of holidays, but they all include autumn holidays, Christmas holidays, Easter holidays and Summer holidays. There are also several bank holidays or religious holidays across the states.
If children don´t achieve minimum standards they have to repeat a year. The scoring system ranges from 1 (very good) to 6 (very poor). At the end of primary school the parents and the childrens´ teachers decide which kind of secondary school the children will attend. Mostly the decision depends on the childrens´ marks. Parents also get a recommendation from the child´s teacher which type of school would suit the child.
Parents have to enroll their child for primary school, usually between six to eleven months before the start of the school year. Children get a medical check to confirm that they are in good health and that they have the cognitive skills to attend school without needing additional support.
If children don´t attend a state primary school the parents have to apply for a private primary school. There are three categories of them:
1) Religious schools are mostly state-subsidized and similar to state primary schools. The main difference is that

They are run by religious institutions. Parents mostly have to pay fees.
2) International schools are mostly located in bigger cities like Berlin or Munich where a lot of international families live. They often offer schooling from the Kindergarten to the end of secondary education. Mostly they are fully independent but they offer and academic education which meets both German and international standards. A lot of offer boarding facilities. Fees are generally very expensive.
3) Alternative schools like the so-called Waldorfschulen or Rudolf-Steiner-Schulen. This kind of schools exist in Germany since the year 1919. They were founded by Rudolf Steiner and they are based on the philosophy of anthroposophy. „It is a formal educational, therapeutic, and creative system established by Rudolf Steiner, seeking to use mainly natural means to optimize physical and mental health and well-being.“ (Oxford Language Dictionary). This kind of school focuses on a child´s creativity and arts. In October 2022 there were 253 Waldorfschulen in Germany and they were attended by about 90.000 children. Waldorfschule also provide Education at Kindergarten and secondary stages. Parents have to pay school fees.

Another kind of an alternative school are the Montessori schools. The first Montessori school in Germany was founded in the year 1923 in Jena. Today there are about 1100 Montessori-Kindergarten and schools. These are method schools based on the principles about child development taught by the doctor Dr. Maria Montessori. They allow children to develop and follow their natural interests. The teachers mainly have a supportive role. The curriculum involves a lot of outdoor-learning. Parents have to pay school fees.

EDUCATIONAL SYSTEM OF BADEN-WÜRTTEMBERG

In the state Baden-Württemberg all paths are open for students- there are a lot of educational pathways. All pathways consider the individual student, so the children are neither undertaxed nor overburdened. Students have to choose after year 4 in primary school what kind of secondary school they will visit. The students can achieve:
1) The general secondary school-leaving certificate (Hauptschulabschluss)
2) The intermediate secondary school-leaving certificate (mittlerer Bildungsabschluss)
3) University entrance qualification (Hochschulreife)
Each of these qualifications offers the possibilty of a further connection.

1) The general secondary school-leaving certificate (Hauptschulabschluss)
After primary school students in Baden-Württemberg can attend a general secondary school (Hauptschule). At the end of year 9 they get a secondary school-leaving certificate. This provides access to either further secondary education or to an apprenticeship. This certificate can also be gotten at the end of year 9 or 10 at an intermediate secondary school with focus on vocational orientation (Werksrealschule). Also at an intermediate secondary school (Realschule) at the end of year 9 or at a joint secondary school (Gemeinschaftsschule) at the end of year 9 or 10 by doing the exam voluntarily. At a (Werks-) Realschule, a Gemeinschaftsschule or at a higher academic secondary school (Gymnasium) you can get this

kind of certificate by success- when students have fully completed year 9 and got access to year 10. They receive written documentation of their level of achievement. You can also get the certificate by completing vocational training in a dual system or in vocational preparation courses.
A general secondary school prepares students for school exam and for the start of vocational training, considering the interests of the students. Beginning with year 7 they get intensive career guidance by work experiences, by close cooperation with the career guidance offices of the employment agencies and by partnerships between schools and companies.

2) The intermediate secondary school-leaving certificate (mittlerer Bildungsabschluss)
There are a lot of possibilites to achieve this certificate, e.g. by completing successfully year 10 in a joint secondary school (Gemeinschaftsschule) or in an intermediate secondary school (Realschule)/ intermediate secondary school with focus on vocational orientation (Werkrealschule). It´s also possible to get that kind of certificate at a higher academic secondary school (Gymnasium) when you completed year 10 and got access to the so-called Oberstufe (years 11 and 12). You can also achieve an intermediate secondary school-leaving certificate with a successful general secondary-school leaving certificate (Hauptschulabschluss) and the subsequent possibilities for further education at vocational schools or by means of the Dual System.
The intermediate secondary school with focus on vocational orientation gives students a fundamental and extended general education and also teaches them real-life topics and tasks.
There has been developed a new education concept for the intermediate secondary school (Realschule) at the beginning of the school year 2017/18. Students at the orientation stage (years 5 and 6) are taught at an intermediate level which leads to the intermediate secondary school-leaving certificate (Realschulabschluss). At the end of year 5 there is no decision taken if students can get into year 6. That means that they don´t have to repeat that year but students with a lower level of achievement can be offered additional support. At the end of orientation stage (year 6) a decision is taken if the student can continue at the intermediate level or should be taught at a lower level leading to a general secondary school-leaving certificate. The different levels can be taught in separate classes or in groups within the same class. At the end of years 7 and 8 a decision is taken to which level the student should continue to learn. The decision is based on the student´s grades. It is possible to change levels at the end of a half-year. In year 10 students are taught exclusively for intermediate secondary school-leaving certificate (Realschulabschluss).
At an intermediate secondary school general subjects like German, Mathematics and English are taught. But there are also compulsory optional subjects. According to their talents students can choose between technology, every-day culture, nutrition and social issues (AES) or a second foreign language, mostly French. The first three subjects start in year 7, the second foreign language in year 6. This kind of school also offers a wide range of opportunities beyond regular lessons, like languages, music und sport. Around 80 intermediate secondary schools als offer bilingual learning. This means that two subjects are taught in English.
This kind of school prepares students for the world of work or for the attendance of a higher vocational secondary school (berufliches Gymnasium).

3) University entrance qualification (Hochschulreife)
With this kind of certificate students can attend general university or a university of applied sciences (Fachhochschule). Students get a university entrance qualification when they graduate from a higher academic secondary school (allgemeinbildendes Gymnasium) or a higher secondary level (Oberstufe) of a joint secondary school (Gemeinschaftsschule). If a student got an intermediate secondary school-leaving certificate after year 10 at an intermediate secondary school (Realschule) or in a joint secondary school (Gemeinschaftsschule) and has the necessary

qualifications to a higher secondary level (Oberstufe) of a higher academic secondary school (Gymnasium) or of a joint secondary school (Gemeinschaftsschule). You can also achieve university entrance qualification through an advanced vocational school (Berufskolleg), through a higher vocational secondary school (berufliches Gymnasium), through successfully completing of a vocational training at a specific advanced vocational school (BKFH) or through a higher vocational school for general education (Berufsoberschule).
Higher academic secondary school (Gymnasium) is the direct way to the university entrance certificate (Hochschulreife/ Abitur) within 8 years after primary school. There are also G9 model schools where students can get their Abitur after 9 years instead of 8 years of school. In that kind of school students are trained in high level in several languages, natural science, the humanities, social sciences, art and music.

Joint secondary schools (Gemeinschaftsschulen) offer the same standard as the lower, intermediate and higher academic secondary school types and the same certificates like the three types of schools. Teaching there is based on the diversity of students. The school is open to all students after primary school and is a compulsory all-day school (year 5 to 10) with subjects and extra-curricular activities spread over the whole school day.

Vocational schools (Berufsschulen) offer a lot of opportunities to acquire further qualifications after a student has finished a school for general education: vocational preparation, vocational training/ qualification or acquiring general qualifications, to get e.g. the general university entrance qualification.
There are different types of vocational schools:
1) Vocational preparation courses
There are a vocational introductory year (BEJ), the pre-qualification year for work (VAB), the vocational training preparation (AVdual) and the full-time vocational school pedagogical practice experience (BFPE). All these courses support the students before the start of a vocational training. Except of the BEJ, students can achieve a general secondary school-leaving certificate (Hauptschulabschluss) in these courses. 7
2) One-year full-time vocational school (1BFS)
It´s a training in the technical field in a dual system. It provides students with the skills required for their work and additionally, general education is deepened.
3) Two-year full-time vocational school (2BFS)
It leads to an intermediate secondary school-leaving certificate /Fachschulreife) in two years. There are three kinds of specialisations: nutrition and health, technical and commercial.
4) Advanced vocational school (Berufskolleg)
After getting the intermediate school-leaving certificate students can attend an advanced vocational school. There are different kinds of disciplines: commercial, technical, home economics, nursing and socio-educational.
5) Vocational school (Berufsschule)
It is part of a dual system: training/ apprenticeship at a company and vocational school.
6) Senior vocational school (Fachschule)
There are one-year or two-year courses in which students can prepare for mid-management or qualify for self-employment. After graduation students can study for a degree.
7) Higher vocational school for general education (BOS)
At the BOS students can deepen general and theoretical education and acquire further educational qualifications.
It´s divided into the one-year intermediate level at the intermediate vocational school for general education (Berufsaufbauschule) and the two-year advanced level. This level leads to a specific university entrance qualification (fachgebundene Hochschulreife) or the general university entrance qualification (for this the student has to learn a second foreign language).

8) Intermediate vocational school for general education (BAS)
It takes one year and there are four specialisations: commercial, technical, home economics/ nursing/ socio-educational and agricultural. The advanced level (BOS, two years) offers more specialisations: technology, economics and social services.
9) Higher vocational secondary school (berufliches Gymnasium)
There students with good grades can acquire the general university entrance qualification (Abitur) after their intermediate secondary school-leaving certificate. That kind of school focuses on the world of work. There are six kinds of specialisations: biotechnology, technical, business, social and health sciences, agricultural sciences and nutritional sciences.
10) Young people with disabilities
They can attend a special vocational school with special kinds of training, mostly in a dual system.

EDUCATIONAL SYSTEM OF BAVARIA

The differentiated Bavarian school system offers a variety of educational paths. Every type of secondary school offers the possibility for school transition or the opportunity to start a vocational training or get the next higher qualification. Every school-leaving certificate opens up new academic possibilities, also higher ones. There are 12 years of school education mandatory in Bavaria: full-time attendance of nine years and compulsory vocational education (three years). Mandatory school attendance definitely ends when students turn 21 or when students have received an intermediate school-leaving certificate.
Most schools in Bavaria have lessons from 8 am to 1 pm. But there are also all-day schools or schools offering all-day classes. A lot of schools offer lunch and/ or support in the afternoon (help with homework, clubs).
After four years of primary school students transfer to a secondary school. There are three different types of secondary school: Mittelschule, Realschule and Gymnasium. After year 6 students can also transfer to a commercial school (Wirtschaftsschule).

1) primary schools (years 1 to 4)
Parents can´t choose a state primary school on their own. Students have to attend the primary school that is responsible for the district where the student lives (Sprengelschule). For exceptions they have to apply formally (Gastschulantrag). School registration for primary schools take place every year in March/ April. All parents with school-aged children receive a formal letter. On registration day parents and children must come in personally. There are different alternatives to regular state primary schools: international schools (mostly in Munich), schools for children with special needs, Diagnosis and Special Support classes (for children with deficits in particular developmental areas), classes with extra support in German language and German classes where students can learn the German language. In year three schools start teaching a foreign language, mostly English. Grade 4 in primary school is very important for the future school career of a child. In May all students get a certificate of transition (Übertrittszeugnis). This certificate states which kind of secondary school is suitable for the child. Recommendation for intermediate level (Realschule) is given with an average grade of at least 2,66 in the subjects German, Maths and Heimat- und Sachkundeunterricht (mixture of geography, history and biology). Recommendation for higher level (Gymnasium) is given with an average grade of at least 2,33 in the subjects German, Maths and Heimat- und Sachkundeunterricht. If parents don´t agree with the recommendation, their children can participate in a three-day-assessment testing period at Realschule or Gymnasium. The children are tested in German and Maths (written and oral tests). If they are marked at least 3 and 4, they have passed the testing. With marks 4 and 4 parents can decide if their children attend Realschule or Gymnasium or not.

2) Mittelschule (years 5 to 9 or 10)
A Mittelschule teaches its students a basic general education and prepares them for the life of work. After year 9 students receive a lower school-leaving certificate or after having taken an additional exam the „Qualifizierenden Mittelschulabschluss". After year 10 (M-Zweig) students receive an intermediate school-leaving certificate.
After completing the Mittelschule students can start an apprenticeship, attend a full-time school-based training at a vocational school (Berufsfachschule), attend a technical school (Fachschule) or a technical academy (Fachakademie) or attend an upper vocational school (Berufliche Oberschule / BOS).
After years 5 to 8 Mittelschule students can transfer to a commercial school (Wirtschaftsschule) to get an intermediate secondary school leaving certificate.
When a child has attended year 5 at a Mittelschule it can go to year 5 in Realschule or Gymnasium. The required average grade for Realschule is 2,5 and 2,0 for Gymnasium (subjects German and Maths).

3) Realschule (years 5 to 10)
A Realschule provides its students with a more extensive general education and the opportunity to achieve higher vocational qualifications. After year 10 and passing an exam students receive an intermediate school-leaving certificate.
After completing the Realschule students can start an apprenticeship, attend a full-time school-based training at a vocational school (Berufsfachschule), attend a technical school (Fachschule) or a technical academy (Fachakademie), attend an upper vocational school (Berufliche Oberschule / BOS), a technical college (Berufliche Oberschule/ FOS) or the senior years of grammar school (gymnasiale Oberstufe).

4) Gymnasium (years 5 to 13)
A Gymnasium teaches its students a higher general education. After 8 or 9 years at a Gymnasium students receive a general university entrance diploma (Abitur) after passing exams. From 2018/19 on Gymnasium will last 9 years, starting at grade 5.

5) Orientierungsstufe
The Orientierungsstufe is an offer which helps students to decide which kind of secondary school is suitable for them. It offers different levels in years 5 and 6. After these two years they choose a secondary school.

6) comprehensive school (Gesamtschule)
In the city of Munich you can attend a comprehensive school. This kind of school combines Mittelschule, Realschule and Gymnasium. Students can receive different kinds of school-leaving certificates (general and intermediate level). For getting their university entrance diploma they have to go to another school after year 10.

7) special needs schools (Förderschulen)
Special needs schools are for students with special educational needs. These are for students with extra needs in the areas of language, emotional and social needs, hearing, seeing, intellectual development and physical and motor development.

8) Schools for the sick (Schulen für Kranke)
These kind of schools provide schooling to students in hospitals and similar facilities.

9) vocational schools

There are different kinds of job-training options: part-time on the job and part-time at a vocational school (Berufsschule), vocational off-the-job training at school (Berufsfachschule) and studies at university, university of applied sciences or college of art. In order to study at an university/ university of applied sciences students need an university entrance diploma. This can be obtained by graduating at a Gymnasium, a FOS (Fachoberschule) or BOS (Berufsoberschule). It also possible to get that kind of certificate through a vocational training and work.

10) SPRINT-classes
SPRINT-classes are at state-run schools. These are intensive language learning classes for foreign students who have recently arrived in Germany (e.g. refugees from Syria in the year 2015). At first students have to attend a Deutschklasse (intensive learning of the German language) at a Mittelschule. Then they can assign to a SPRINT-Klasse at a Realschule. They need a recommendation from the Mittelschule.

11) Ukrainian refugees
At the moment there are about 20.000 Ukrainian refugees attending Bavarian schools. They are taught in about 1.000 so-called educational welcome-groups. Aim is to teach them the German language, so that they can attend regular classes. These educational welcome-groups are in primary schools and in all kinds of secondary schools. A lot of teachers in these groups are Ukrainian refugees (about 900 of 2.500).

EDUCATIONAL SYSTEM OF BERLIN

In Berlin many different educational pathways can lead to a school-leaving certificate. Every child gets the best possible support for its qualifications and needs. After a one-to-three-year intitial phase of school education and four more years in a primary school students can transfer to a secondary school.

Early Education takes place in Daycare Centres. These Centres are run by professionally tested pre-school teachers. They teach basic knowledge, skills and abilities for the future (school-) life of children. They ensure that all children receive the best possible conditions for their further education.

Primary schools in Berlin are all-day schools. Parents can send their children half-day or all-day (open or bound all-day). In an open all-day school lessons take place from 7.30 am to 1.30 pm. At that time children are supervised at school. In a bound all-day school educational offerings take place from 7.30 am to 4.00 pm. This offering is free for parents. There is a flexible initial phase of education, that means the first and the second school year are considered as a unit to find out the strenghts and weaknesses of every child. All children learn together and students who need special support can get extra lessons for special educational support- in class or in small temporary groups. If a child needs more time it can stay in the initial phase for a third year- thereby they won´t have any disadvantages. Faster learners can attend class three after just one year. In many primary schools rhythmization was established. That means it´s an open design of the school day, structured by the individual school according to its needs. This can maybe be a sliding start, teaching blocks instead of 45-minute lessons, open final phases or active breaks. In grade three Berlin primary schools start to teach the first foreign language (two hours a week) - students can choose between English and French. At the end of the school year in the initial phase students receive a certificate with an assessment of their learning and competence development. It´s in a table form. In grades three to six they get certificates, in grade three and four it can be replaced by a verbal assessment.

After year 6 students and their parents have to choose a secondary schools. There are several possibilities:

1) Integrated Secondary School (ISS)
This kind of school offers all school-leaving certificates- from general vocational qualifications (end of year 9 or 10) to university entrance level (Abitur). Each single student will be optimally supported and challenged. There are learning teams and individual work at stations, small groups, projects and learning areas. There are all-day offerings and students can take part in sport, musical or artistic activities. If the ISS does not have its own upper secondary school (after year 10 and an intermediate school-leaving certificate) it can enter a cooperation with another school. The upper secondary school at the ISS usually lasts three years but very good students can complete it within two years. All ISS offer practical and job-oriented learning from grade 7 to 10. There are cooperations with businesses and providers of vocational training.

2) Gymnasium
Students at a Gymnasium can attend their university entrance certificate (Abitur) after 12 school years. Many Gymnasium are specialised (e.g. sports, music, languages or science).

3) Comprehensive school
In that kind of school students learn together from their first to their last school year. Students can reach all school leaving certificates.

4) Vocational Gymnasium/ Upper Level Centre (OSZ)
They offer a wide variety of options for professional qualifications. It starts with preparation for vocational training up to the school-leaving certificate to university/ university of applied sciences entrance qualification. They work together with companies.

5) Schools with a Special Educational Focus
It is also known as a special needs centre/ school. There are taught students who have special educational needs.

Educational system of Brandenburg

The federal state Brandenburg surrounds the German capital Berlin, so a significant number of Brandenburg population is concentrated around Berlin. Thereby the educational systems of Brandenburg and Berlin are very similar. Mandatory school attendance in both federal states is ten years. Primary school lasts in both states six years- talented students can go to secondary schools in classes for talented children from grade 5.
There are different types of school leaving certificates students can get:

1) Berufsbildungsreife (BBR)
It´s a lower general education certificate.

2) erweiterte Berufsbildungsreife (EBR)
You can get it after grade 10 in all types of schools, then you can attend professional schools (Berufsschule, Berufsfachschule).

3) Fachoberschulreife (FOR)

It´s an intermediate education certificate (after grade 10 in all types of school), after that, with good grades, you can attend a Fachoberschule or a Berufliches Gymnasium.

4) Fachhochschulreife
It´s a certificate to attend institutions for higher education, but not for universities.

5) Allgemeine Hochschulreife
It´s a certificate to attend all kind of universities, after receiving a general university entrance certificate (Abitur). You can get it at a Gymnasium, a Berufliches Gymnasium and a Berufsoberschule (with a second language).

Kinds of secondary schools in Brandenburg are:
1) Oberschule (year 7 to 10)
This kind of school concentrates on learning and on vocational guidance. You can reach two different kinds of school leaving certificates- the EBR and the FOR. It is also possible to get a permission to attend gymnasium classes at a Gesamtschule. There are two ways of teaching: cooperative (children with different abilities are taught together) and integrative (classes are divided, according to the students´ levels).

2) Gesamtschule (year 7 to 13, years 11 to 13 for getting Abitur)
It is a general school, teaching all children together. You can reach different kinds of school leaving certificates- the EBR (after year 10), the FOR (after year 10), general university entrance certificate (after year 13). Teaching at that kind of school is divided into two levels: regular and advanced.

3) Gymnasium
There you can get your Abitur after year 12.

Vocational schools in Brandenburg are merged in Oberstufenzentren (OSZ).
1) Berufsschule
These are dual schools where you can acquire a profession. You can attend it after getting an EBR after year 10.

2) Berufsfachschule
It´s a full-time basic vocational education (e.g. for social assistants). These schools also have a one-year training for people who didn´t find a place in a vocational school, but have to continue their education.

3) Fachoberschule
You can enter that kind of school after year 10 (for two years, you must have at least FOR) or with completed vocational education (one-year-learning). Two-years students can study technics, economics and management and social profiles. One-years students can study technics, economics and management, social profiles, nutrition, agriculture or design. You can also study remotely via Telekolleg.

4) Berufliches Gymnasium (Abitur after year 13)
There are three kinds of profiles: social, equipment (electrical or mechanical engineering, design, media) and economics. You need the FOR to attend that kind of school.

5) Fachschule
These are advanced training schools.

Educational system of Bremen

In Bremen there is also compulsory education from the age of six. This obligation ends after twelve school years. The school system of Bremen consists of different elements:

1) Kindertagesstätte
These are day-care centres for children from 0 to 6 years.

2) Primary school
It´s for children from 6 to 10 years, then the children have to attend secondary schools. 18 months before primary school starts the German language skills of the child are tested. If they are not well enough, the child can take part in the pre-school language training.

3) Secondary school
There are different kinds of secondary schools: Freie Schulen, Gymnasien and Oberschule.
Freie Schulen (free or alternative schools) consider the individual needs of every student, they have different educational focuses.
The majority of children attend the Oberschule. It includes all grades (5 to 13) and leads to all common school-leaving certificates (general and intermediate school-leaving certificate and general university entrance certificate). Students are taught together until year 10 in different kinds of levels. After year 10 students have the option to transfer to a Gymnasiale Oberstufe.
Gymnasium is divided into two levels. Secondary level I extends to year 9. After year 9 starts the gymnasiale Oberstufe. The number of lessons increases. In year 10 students go through an introductory phase. After finishing it they reach an intermediate school leaving certificate. Year 11 and 12 are the qualification for the Abitur (general university entrance certificate). In all Gymnasien English lessons start in year 5. Beginning with year 6 students have to choose an additional language (mostly French, Latin or Spanish).
In the year 2009 a new type of school was launched: the Werkschule. It´s for students who are less interested in theoretical learning. It´s a three-year course from year 9 to 11 with a strong practical orientation. After year 11 students achieve and extended secondary school leaving certificate.

4) Vocational schools
They prepare students for working life.

Educational system of Hamburg

In Hamburg the State Ministry of Schools and Vocational Training (Behörde für Schule und Berufsbildung) is responsible for the educational system of the federal state. The State Ministry of Science and Research (Behörde für Wissenschaft und Forschung) is responsible for university and college education. In Hamburg there is also the UNESCO Institute for Lifelong Learning.
In primary school (year 1 to 4) are taught: reading and writing the German language, mathematics, English, music, art and PE. After primary school (after year 4) children can choose between different types of secondary schools: general secondary school (Hauptschule), intermediate secondary school (Realschule), higher academic secondary school (Gymnasium) and comprehensive schools (Gesamtschulen). The choice which school they apply for is made by the parents.
If parents choose the higher academic secondary school (Gymnasium) the child has to attend it for 8 years. At the end, after year 12, they get the University entrance qualification (Abitur).

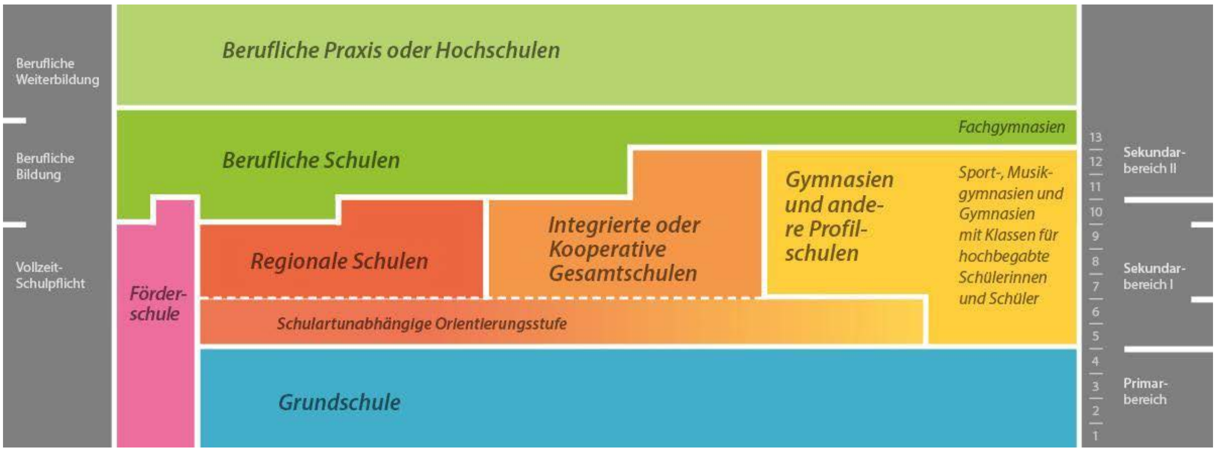
The Stadtteilschule is a special kind of school in Hamburg, it´s a comprehensive school. There children can get a general secondary school-leaving certificate, an intermediate secondary school-leaving certificate and an university entrance qualification. After year 9 or 10 they can choose if they leave school to do an apprenticeship/ vocational training or if they want to do their A-levels in year 13. Then they can go to university.
All state schools in Hamburg offer a fully-day care from 8am to 4pm. In the afternoon students can do their homework and attend workshops (e.g. sport, music, art, drama, handcraft).
There are also an International School and a French school in Hamburg where you can receive international certificates (International Baccalaureate, French baccalauréat or AbiBac: German-French baccalauréat).
There are around 20 universities and colleges in Hamburg with about 43,000 students. The Bucerius Law School is the only private Law School Germany. And the HafenCity Universität (University of the Built Environment and Metropolitan Development) is the only university in Europe which researches and teaches what the future of metropolitan areas could and should look like.

Educational system of Hessen

In Hessen compulsory schooling lasts for twelve years. Full-time compulsory education ends after nine/ ten years. Pre-school education is optional for children from age one to five.
Primary school lasts from year one to year four (age 6 to 9). Some primary schools offer pre-school classes for children who have reached school age, but need special support.
After primary school students have to decide on a secondary school. They can attend a Gesamtschule (grade 5 to 10) and after that they can attend a Berufliches Gymnasium. It also possible to attend a Gymnasium (grade 5 to 13) and get an general university entrance certificate. They can also attend a Realschule (grade 5 to 10, intermediate school leaving certificate) or a Hauptschule (grade 5 to 9/10, general school leaving certificate). After a Realschule they can transfer to FOS/BOS to get an higher university entrance school leaving certificate (general university or university of applied sciences). After Hauptschule or Realschule students attend a school for vocational training (Berufsschule).
In Hessen there is also a concept for „Lifelong Learning-Schools for Adults“. Employed and unemployed people can take part in this programme. Employed people can attend companies´ own trainee programmes or take courses of commercial organizations. Unemployed people can attend free day or evening courses to prepare for working life or getting a school degree. There are also courses for integration of immigrants.

Educational system of Mecklenburg-Vorpommern

The educational system of Mecklenburg-Vorpommern is open to all students and provides different pathways for children with all kinds of needs and abilities. Students can easily change between the different pathways.



Source: https://www.regierung-mv.de/Landesregierung/bm/Schule/Schulorganisation/Schulsystem-im-%C3%9Cberblick/

Primary school lasts from year one to year four. Years one and two are an orientation phase, considering the individual abilities of every child. Orientation phase can also take place until three years. In years one and two students don´t get marks. After year three they need a certificate to transfer in a higher class. In year three schools start teaching a foreign language, mostly English.
After primary school there is a Orientierungsstufe (at regional or comprehensive schools). In these two years (grade five and six) children are supported individually and they can find out what kind of school suits for their abilities. After these two years students get a recommendation which kind of secondary school they should attend.
Regionale Schulen (regional schools) teach a basic education and prepare students for work life. After year nine students obtain a basic school leaving certificate and can start an apprenticeship (dual way, combined with visiting a vocational school). After year ten they can get an intermediate school leaving certificate or they can transfer to a Gymnasium when they have good grades. There they can get a university entrance school leaving certificate after year twelve.
There are two different kinds of comprehensive schools: kooperative Gesamtschulen (KGS) and integrierte Gesamtschulen (IGS). At a KGS are different kinds of pathways, at an IGS students just divided in different subjects (basic and advanced level).
All lot of schools in Mecklenburg-Vorpommern are all-day schools where students get help with homework and can attend different kinds of clubs (e.g. sport, art, music).

EDUCATIONAL SYSTEM OF NIEDERSACHSEN

In Niedersachsen school is compulsory for each child who has reached the age of six and compulsory education lasts for twelve years.

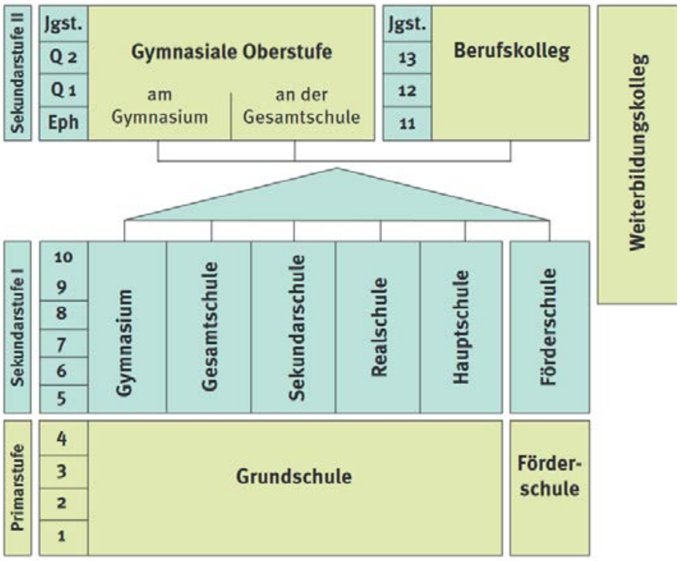
There are Education authority areas (school districts) for primary schools. The child has to register with the school in whose district the child lives. Primary schools lay educational foundations within four years. They get knowledge and skills in German, mathematics, English, general studies (history, social studies, political and economic studies, geography, science and technology), music, art, PE and RE.

After year four all students have to attend a secondary school. After recommendation of the teacher parents decide which kind of secondary school their child should attend. They can choose between special needs schools (Förderschulen), lower secondary school (Hauptschule), intermediate secondary school (Realschule), integrated Haupt- and Realschule (Oberschule), comprehensive school (Gesamtschule) and upper secondary school (Gymnasium). All these schools lead to different kinds of school leaving certificates (basic, intermediate and upper level).

Depending on the kind of reached level vocational training can be started or school education can be continued. Vocational training schools offer a wide range of opportunities.

EDUCATIONAL SYSTEM OF NORDRHEIN-WESTFALEN

Compulsory schooling starts in Nordrhein-Westfalen at the age of six. Children have to attend primary school from year one to four. Then they have to choose a secondary education. They can choose between a Hauptschule (year five to ten), a Realschule (year five to ten), a Gymnasium (year five to nine), a Gesamtschule (year five to ten) and a Sekundarschule (year five to ten). After year nine at a Gymnasium students can attend the subsequent Gymnasiale Oberstufe (three years, until year twelve). All these schools lead to different kinds of school leaving certificates (basic, intermediate and upper level).
At a Berufskolleg students can attend vocational training programmes or attend a higher-level school leaving certificate.
Förderschulen are for students with special needs. In a Weiterbildungskolleg people who are working or people with previous work experience can attend better qualifications and/ or school leaving certificates.



Source: https://www.bra.nrw.de/system/files/media/document/file/flyer_nrw_schulsystem_a4_englisch_0.pdf

EDUCATIONAL SYSTEM OF RHEINLAND-PFALZ

The state of Rheinland-Pfalz has got a diverse school system. In the year 2001 all-day schools (8 am to 4 pm) were introduced in Rheinland-Pfalz. It also offers the freedom to choose learning materials with school-book lending and free pupil transportation.

Primary school lasts from year one to year four. There children can learn English or French from their first year in a basic way. The children´s language progress is documented in a special portfolio.
After that students have to decide what kind of secondary school they want to attend. There are three different types of secondary schools:

1) Realschule Plus (around 180 schools)
Students have to attend that kind of school for five or six years. They get education in basic subjects (like mathematics and German) but there are also compulsory optional subjects in technology, sciences, economics, social studies and a second foreign language from year six onwards. Specialised secondary education can lead to a university entrance qualification. Specialisation is possible in three branches: economics and administration, technology and health.
2) Integrierte Gesamtschule (around 50 schools)
Students have to attend that kind of comprehensive school for five to nine years. Some integrated comprehensive schools offer special options, e.g. they belong to the group of elite football schools or they cooperate with theatres and universities.
3) Gymnasium (around 150 schools)
Students have to attend it for nine years.

In all three types of secondary schools students can achieve different diplomas (basic or intermediate school leaving certificate up to a university entrance qualification).

There are also schools for students with special needs, e.g. learning problems, social and emotional needs or needs in hearing or seeing.

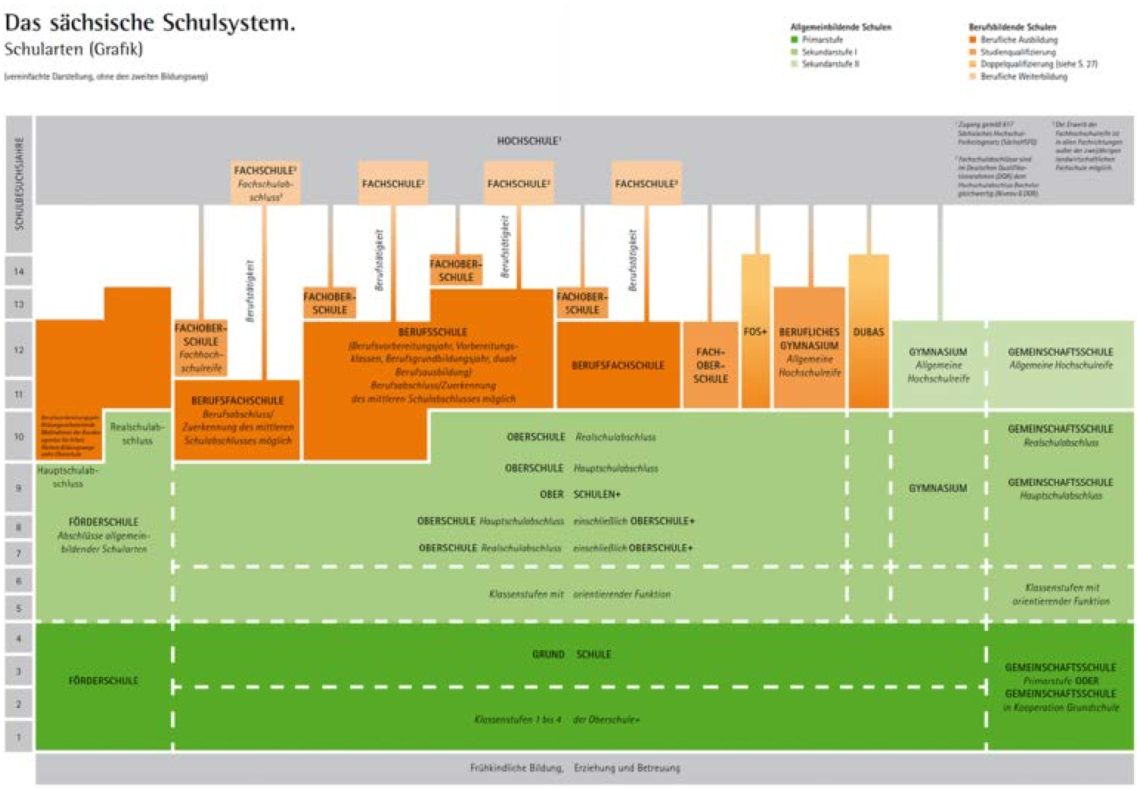
After secondary school students can start studying (with a university entrance qualification) or start an apprenticeship/ vocational training. Trainees in a job attend both the company in which they can learn their chosen occupation and a vocational school in which within three years theoretical basics are taught. There are more than 100 vocational schools in Rheinland-Pfalz.
If students want to start studying after achieving their university entrance qualification they can do it in Rheinland-Pfalz which has a dense network of universities and research institutions. There are e.g. the TU Kaiserslautern, the universities of Koblenz-Landau, Mainz and Trier and the German University of Administrative Sciences. There are also various universities of applied sciences.

EDUCATIONAL SYSTEM OF SAARLAND

In Saarland students can choose after year four, when they have finished primary school, if they want to attend a Gymnasium or a comprehensive school. In both kinds of secondary schools a student can attend a university entrance certificate, at a Gymnasium after twelve school years and at a comprehensive school after thirteen school years.
At a Gymnasium children are taught together up to year ten, then the Oberstufe starts. Students can achieve a university entrance school leaving certificate.
In a comprehensive school you can achieve different kinds of school leaving levels (basic, intermediate and university entrance school leaving certificate). If a comprehensive school doesn´t have a gymnasiale Oberstufe, it can cooperate with Gymnasien. Some subjects are compulsory at a comprehensive school: German, mathematics, foreign language (English and French), STEM subjects, history, geography, politics, economics, RE, PE, art, music). There are also a skill lesson (Lernen lernen) and a class teachers´s lesson in years five and six. In class

seven they can choose a second foreign language. Some subjects are taught in a basic and in an advanced level. Every semester students are tested which kind of level they should attend. Beginning with year seven students have to choose a compulsory optional subject (e.g. a language, economics). There is also vocational preparation in form of internships and visiting companies.
Until year eight students don´t have to repeat a school year, but they can repeat voluntarily. After finishing school it depends on the achieved certificate if students do a vocational training or if they start studying.

EDUCATIONAL SYSTEM OF SACHSEN



Source: https://www.schule.sachsen.de/saechsisches-schulsystem-3979.html

In the school system of Sachsen there are many roads to success as you can see in the picture. It offers opportunities to everyone to achieve the best school leaving certificate according to ones needs and abilities. For that students get the best individual support. There are also alternative educational pathways for adults, for example at night secondary schools.

EDUCATIONAL SYSTEM OF SACHSEN-ANHALT

In the state of Sachsen-Anhalt students has, like in every state, attend primary school at the age of six. Then they have to choose a secondary school which all lead to different kinds of school-leaving certificates (basic, intermediate and higher level).
Sachsen-Anhalt has a wide range of school types: all-day schools, primary schools, secondary schools, grammar schools and schools for children with special needs in state or private sponsorship. At a grammar school students achieve their A-level (Abitur) after year twelve.

Educational system of Schleswig-Holstein

In July 2022 there were around 800 public schools in Schleswig-Holstein and approximately 28.300 teachers taught around 379.00 students.
Children from age 0 to six can attend a Kindergarten in Schleswig-Holstein and at the age of six they have to attend primary school. After four years they move on to a secondary school. There are different kinds of secondary schools: comprehensive schools, regional schools or grammar schools (Gymnasien). Every third school is an all-day school. That means students get lunch at school, homework supervision and they can attend different clubs.
There are also Europe Schools (since 1996) - these are schools with a special European focus.
In all kinds of secondary schools students can reach different levels of school leaving certificates. When they achieve an university entrance diploma, they can start studying.
There are a lot of public institutions of higher learning in Schleswig-Holstein. There are e.g. universities in Flensburg, Lübeck and Kiel, a number of universities of applied sciences (public and private ones), a Conservatory in Lübeck and an Academy of Fine Arts in Kiel.

Educational system of Thüringen

In Thüringen children start school at the age of six. School attendance is compulsory until year ten.

1) Primary school
Children aged between six and ten attend a primary school. They can also attend the primary classes of a comprehensive school (Gemeinschaftsschule). Primary schools are last from grade one to four. After this time students and parents have to decide what kind of secondary school they want to attend. If they are already in a comprehensive school, they can stay there until grade twelve.

2) Secondary schools
Children aged between ten and sixteen have to attend a secondary school, depending on their abilities and needs. There are different kinds of secondary schools: Regelschule (basic secondary school), Gesamtschule (comprehensive school), Förderschule (school for children with special needs) or Gymnasium (grammar school).
In a Regelschule students can obtain a basic secondary school leaving certificate (Hauptschulabschluss) after year nine and an intermediate school leaving certificate (Realschulabschluss) after year ten. Then they can start a vocational training.
In a comprehensive school students can obtain all kinds of qualification- from intermediate qualifications to the Abitur (general university entrance qualification). Children can attend it beginning with year one or beginning with year five. Until year eight all students learn together, then they are prepare for their final school exams in different courses.
A Förderschule is a school for students with special needs and severe disabilities who can not attend another kind of secondary school.
A Gymnasium teaches students a higher education and prepares them for Abitur exam (GCSE-A levels).

Students aged sixteen or older can attend their general university entrance certificate when they are good enough at Gymnasium or comprehensive school. The other students go to a vocational college. There they can obtain further qualifications.

University

In Germany students can choose between different types of higher education institutions. They can attend universities, universities of applied sciences, private universities and universities of cooperative education, depending on the area of specialisation.
In winter semester 2021/22 were 2.95 million students in Germany, including about 415.000 international students.
Universities offer a wide range of different subjects, but some are specialised and call themselves technical universities. Some universities, like the Sportuniversität Köln, focus on a single subject area. Most universities in Germany are public. Students only have to pay an administration fee (between 100 to 350 Euros per semester).
Universities of applied sciences are practice-orientated. They focus on specific fields like economics, media, science, social work or technology. There are theoretical phases and practical phases. In practical semesters students have to do internships. Sometimes students do a dual study programme which combines academic studies with practical phases in a company.
Colleges of art and music train young artists (e.g. musicians, designers). If you want to attend a college of art and music you have to do an entrance examination to show your talent.

Special needs education

Special needs education means specific support for children with learning disabilities or with longer term disorders.
It is classified in the following categories: blind or deaf students, visually or hearing impaired students, physically or mentally disabled students, sick students, students with impaired speech, students with learning difficulties like dyslexia, students with autism, students with Attention Deficit Disorders and students with behavioural problems.
The Grundgesetz, the German Law, forbids discrimination on the basis of physical or mental disability. So each federal state in Germany deals with students with special needs in different ways. But in nearly all of them parents can choose the school they prefer, even for students with severe disabilities.
Each state has special schools for students with a variety of special needs, like mental, social-emotional or physical disorders. They are called „Schools with a special educational development focus“ (Schulen mit sonderpädagogischem Förderschwerpunkt). Some schools are day schools, others are boarding schools. Sometimes there are joint activities between schools for disabled students and non-disabled students.
There are also programmes which encourage the integration of students with special needs into mainstream education in public schools. This is called „Inklusion“. To get part in the programme a diagnosis of a disabled student must also be authorised by the local education authority. In some federal states these children get extra lessons in the afternoon.
In public schools for students with dyslexia diagnosis the school psychologist and/ or specially trained teachers work out a special learning programme. That may contain additional time at exams, providing special working tools, replacing written exam by oral testing or reading the text of written exercises to the student.

The Volkshochschule (VHS)

The Volkshochschulen are Adult Education Centres in Germany. About 900 Volkshochschulen all around Germany offer around 700.000 events in almost 3.000 branches in a year. Mainly they offer courses, but you can also attend lectures, study trips and excursions. There are about nine million participants who attend the VHS.

Source: https://www.volkshochschule.de/verbandswelt/dvv-english/adult-education-centres-germany.php

In rural regions the Volkshochschulen are often the only adult education centres. They are very often supported by the local municipalities. The Volkshochschulen form a nationwide network which provides lifelong learning with their offers for everybody. They are open to all kind of people regardless of age, gender, origin, religion, educational level or social status. The fees are not high so that everybody can afford to attend the courses. More than one third of their financial ressources come from enrollment fees. They also get public subsidies.

The programme of the Volkshochschulen is divided into seven key programme areas which everbody can attend:

1. Language courses (also German as a second language)

2. Culture and creativity

3. School-leaving qualifications

4. Work and career

5. Basic education

6. Politics, society and environment

7. Health courses

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2.4. GREECE

Age levels and grouping of pupils
Compulsory education in Greece lasts 11 years and extends from the ages of 4 to 15.
Primary education includes pre-school (*nipiagogeio*-Kindergartens) and primary education (Primary Schools).
Secondary education in Greece is divided into two cycles: compulsory secondary education and non-compulsory secondary education ("Eurydice: National education systems: Greece", n.d.).

1. **Compulsory secondary education** is provided in lower secondary school, day and evening. It lasts for three years.

2. The **secondary non-compulsory education** that follows is distinguished:

- In the **general** provided in the **General upper secondary schools**, day or evening, three years of study.
- In the **vocational**, provided:

  - In **Vocational upper secondary schools**, day or evening, three years of study.
  - In the **Vocational Training Schools**, day or evening, two years of study.
  - In the **Vocational Apprenticeship Schools of Manpower Employment Organisation**, two years of study.

The following table shows the age of students with regards to the types of schools (primary – secondary education) and the grades they attend.

	Compulsory											Non-Compulsory		
Type of School	Pre-school		Primary school						Lower Secondary Education			Upper Secondary Education		
Grade	toddlers	greattoddlers	1st	2nd	3rd	4th	5th	6th	A	B	C	A	B	C
Age	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18
												General & Vocational		

PRIMARY EDUCATION

Organization of the school year

The organization of pre-school and primary education school time is determined at central level (presidential decree 79/2017). It is applied to all pre-schools and primary schools. The school year for both public and private pre-school and primary education schools starts on the 1 September and ends on the 31 August of the following year. The teaching year starts on the 1 September and ends on the 21 June of the following year, while lessons start on the 11 September and end on the 15 June of the following year. The school year is divided into three terms:

- **1st term**: from the 11 September to the 10 December

- **2nd term**: from the 11 December to the 10 March
- **3rd term**: from the 11 March to the 15 June.

During the school year, there are short breaks – during Christmas and Easter – of 4 weeks in total. Pupils' summer break starts on the 16 June and ends on the 10 September.

The teaching days in pre-school and primary education amount to 170 days per year, i.e. a total of 35 weeks per year, 5 days each (Monday to Friday).

ORGANISATION OF THE SCHOOL DAY AND WEEK

- **Nipiagogeio (pre-school –Kindergarten)**

Public Kindergartens (State pre-schools - Nipiagogeia) operate from Monday to Friday. In addition to the compulsory program common to all toddlers/pre-toddlers, the Unified Type All-day Kindergarten includes a full-day optional operating program - which requires at least 5 students (toddlers/pre-toddlers) to operate.

The compulsory opening hours in the Single Type Full Day Kindergarten **start at** 8:30 and run until 13:00 (25 teaching hours per week), while the new optional upgraded non-compulsory full-day program runs until 17:30.

Parents of students enrolled in the non-compulsory full-day program (13:00-17:30) have the possibility to apply for early arrival classes (07:45 to 8:30). The departure of Kindergarten students attending the optional program of the upgraded full-day kindergarten takes place either at 16.00 at the end of the fourth (4th) teaching hour or at 17.30 at the end of the program. The minimum number of students for the operation of the 5th and 6th teaching hours of the new, upgraded full-day Kindergarten program for the single-seat kindergartens is five (5) toddlers/toddlers (Law 4957/2022, art. 371, par.3c).

- **Dimotiko scholeio (primary school)**

State primary schools operate from Monday to Friday. Single type of all-day primary schools administer a compulsory programme of subjects for all pupils at all grades as well as an all-day schooling programme (non-compulsory). The minimum number of pupils for the non-compulsory all-day programme is 14. Compulsory opening hours for single type of all-day primary schools are 8:15 to 13:15 for all classes. For non-compulsory all-day programmes, the timetable is extended to 16:00 in half of the primary schools in the territory and at 17:30 in the rest that have been selected to pilot the new upgraded full-day Primary School program (M.D. F.7/FM/98404/D1/2022).

Parents of pupils that have enrolled in the non-compulsory all-day programme (13:15-16:00) have the option to apply for early arrival classes (07:00 to 8:00).

The new, Upgraded Full Day Elementary School Program (Law 4957/2022, art. 371, par.2c) develops in three (3) zones:

i) "Lunch - Nutrition education".

ii) "Study-Preparation" in language and mathematics is included, or it may include one (1) teaching hour with one or more of the following subjects: English, sports, visual arts, music, theater education and information and communication technology (ICT).

iii) "School Educational Clubs", which includes, for two consecutive hours every day, with a break of a few minutes in between, the school educational clubs.

The departure of Primary School students attending the upgraded full-day Primary School program takes place either at 15:50, at the end of the second teaching hour of the 2nd zone, or at 17:30, at the end of the program. Especially, in the 2022-2023 school year, the departure can also take place at 14.55, at the end of the first teaching hour of the 2nd zone.

Curriculum

- **Nipiagogeio (pre-school)**

The content of learning in kindergarten is organized into four (4) Thematic Fields based on the holistic approach to learning, with the aim of highlighting interdisciplinary connections and strengthening cross-curricular unification (M.D. 160476 /D1/2021, A Part, unit C) .

● **First Thematic Field: Child and Communication.** The two Thematic Units that make up the specific Thematic Field, Language and Information and Communication Technologies (ICT), have a key role in the Study Program and form the basis for all the Thematic Fields.

● **Second Thematic Field: Child, Self and Society.** The two Thematic Units, Personal and Socioemotional Development and Social Sciences, complement each other in order to shape appropriate learning experiences that promote development at an intra-individual, interpersonal and social level.

● **Third Thematic Field: Child and Sciences**. The Child and Science Thematic Area focuses on the joint processes that take place dynamically, interactively and complementarily, when children construct concepts in Mathematics, Science and Construction Technology.

● **Fourth Thematic Field: Child, Body, Creation and Expression.** The two Thematic Units that make up the specific Thematic Field, Kinetic Education and the Arts, complement each other in order to promote the motor and artistic expression of children and promote the acquisition of lifelong habits of mental alertness, dexterity and physical well-being.

With the Ministerial Decision F.31/94185/D1/2021(4), art. 1, Skill Development Workshops (which are referred to thoroughly in a later section) have been deployed in all classrooms across the country.

From the school year 2021-2022, the English language will be introduced to the morning compulsory program of the country's Kindergartens through creative activities, of an experiential nature, for two teaching hours per week.

Didactic framing – Design of Learning.

Based on Ministerial Decision 160476 /D1/2021, A Part, unit D the learning processes in kindergarten are as follows:

- Exploratory learning
- Playful learning
- Cooperative learning
- Learning for all

Specifically with Playful Learning, children develop internal motivation for learning and are actively involved in activities when they include playful characteristics or have a playful mood.

Finally, the learning frameworks in the kindergarten are the following:

a) Play, free and organized,
b) The investigations,
c) Everyday and occasional situations (such as celebrations, cultural events and family habits),
d) The supporting activities,
e) Classroom routines,
f) The break,
g) Transitions between program activities.

Regarding the **game**, free and organized, it is worth noting that according to Ministerial Decision 160476/D1/2021, A Part, unit D, whether it is developed by children in the context of free activities, or organized with the help of kindergarten teachers in more structured activities, it is a source of pleasure and learning.

- **Dimotiko scholeio (primary school)**

The Curriculum concerning subjects taught within the compulsory teaching hours are mandatory for all students in the same class of the Primary school, both in terms of their content and the distribution of the material in the 6 classes of the Primary school.
The teaching subjects of the Uniform Full-Day Primary School and the Primary School Weekly Timetable (EOP) based on the Ministerial Decision F.31/94185/D1/2021(4), art. 2, are structured as shown in the following table:

Weekly Time Schedule of Elementary school							
	Subjects	Grades					
		1st	2nd	3rd	4th	5th	6th
1	**Religious Education**			2	2	1	1
2	**Language teaching**	9	9	8	8	7	7
3	**Mathematics**	5	5	4	4	4	4
4	**History**			2	2	2	2
5	**Environmental Study**	3	3	2	2		
6	**Geography**					1	1
7	**Natural science**					3	3
8	**Civics Education**					1	1
	Arts Education						
	Visual Arts	2	2	1	1	1	1
	Music	1	1	1	1	1	1
9	**Drama**	1	1	1	1		
10	**Physical Education**	3	3	3	3	2	2
11	**English**	2	2	3	3	3	3
12	**Skill Laboratories**	3	3	2	2	1	1
13	**2nd Foreign Language**					2	2
14	**I.C.T.**	1	1	1	1	1	1
	TOTAL	30	30	30	30	30	30

Pupil assessment

- **Nipiagogeio (pre-school)**

In *Nipiagogeio* there is no standardized path to learning and alternative forms of assessment are prevailing.

- **Dimotiko scholeio (primary school)**

In *Dimotiko scholeio* the assessment of the progress of pupils is a continuous and advisable process and within this framework the assessment of the pupils' performance is conducted in each subject of the curriculum of the relevant school year and pupils receive a Performance Assessment (with a descriptive assessment and a grading scale for certain grades). Pupils that graduate form Nipiagogeio receive the **Attendance Certificate** and pupils who graduate successfully from *dimotiko scholeio* are awarded the primary school leaving certification (known as **Leaning Certificate**), which includes their general average grade. There are no national exams at this level of education.

Secondary education

General Compulsory lower secondary education

- **Gymnasio (lower secondary schools)**

General lower secondary education lasts 3 years and is provided in **gymnasia (lower secondary schools)**. Students follow a common curriculum, without any differentiations. In addition, some lower secondary schools offer an experimental curriculum or are oriented towards students with specific inclinations or educational needs. The schools which provide compulsory secondary education and lead to the relevant certificates are the following:

- **Imerisia gymnasia (day lower secondary schools)** are the main providers of general compulsory secondary education. They are attended by the majority of students in secondary education. They constitute over 90% of the educational institutions providing general compulsory secondary education. (1554 day lower secondary schools).
- **Esperina gymnasia (evening lower secondary schools)** are attended by students over 14 years old, who are employed. (74 evening lower secondary schools).
- The **Model Schools and the Experimental Schools.** (19 Model lower secondary schools, 16 Experimental lower secondary schools).
- The **Music schools** (51 music schools).
- The **Art Schools** (9 Art Schools).
- **General ecclesiastical secondary schools** (7 Ecclesiastical Secondary Schools).
- The **minority education** (2 Minority lower secondary schools in Thrace).
- **Intercultural Education Schools** (8 Intercultural Gymnasiums).
- **Second chance schools** (86 Second chance schools)

General Non-Compulsory Upper secondary education

- **Geniko lykeio (upper secondary schools)**

General non-compulsory secondary education is offered at lykeia (upper secondary schools). Attendance lasts 3 years and includes grades A, B and C. There are also upper secondary schools which offer experimental curricula or are oriented towards students with specific inclinations or educational needs. In this context, the types of schools that provide general non-compulsory secondary education and award equivalent certificates are the following:

- Imerisia genika lykeia (day general upper secondary schools) constitute the main provider of general non-compulsory secondary education as they are addressed to the majority of pupils selecting general education at this educational level. Day general lykeia amount to 1.111.
- Esperina genika lykeia (evening general upper secondary schools) are attended by working pupils, who wish to complete their school education. More specifically, adults and working underage individuals are eligible to enroll. In Greece, esperina genika lykeia amount to 78.
- The Model Schools and the Experimental Schools (18 Model upper secondary, 9 Experimental upper secondary schools)
- The Music schools. (47 music schools)
- The Art Schools. (6 Art High Schools)
- The General ecclesiastical secondary schools. (10 General Ecclesiastical Lyceums)
- The upper secondary schools of special education and training (6 public upper secondary schools of special education)
- There are currently two Minority upper secondary schools in Thrace.

- Two Muslim seminaries of Thrace - religious schools
- The Experimental Schools of Intercultural Education (5 Intercultural Lyceums)
- The School of European Education in Crete.

Vocational Non-Compulsory Upper secondary education

Vocational non-compulsory secondary education is offered at epangelmatika lykeia (vocational upper secondary schools - EPAL), day or evening. Epangelmatika lykeia administer two cycles of study:

- The secondary education cycle, which is part of the formal educational system
- The 'post-secondary year - apprenticeship class', that is a post-secondary education cycle, which is part of formal vocational training. School leaving certificate holders, secondary education cycle EPAL degree holders, are eligible to enrol in 'post-secondary year - apprenticeship class'.
- The types of institutions offering vocational secondary education are summarised, as follows:
- Day vocational upper secondary schools. Attendance at imerisia epangelmatika lykeia (day vocational upper secondary schools) is of 3-year duration and includes A, B and C grades. Gymnasio school leaving or equivalent certificate holders are eligible to enrol in grade A without entry examinations. Day vocational lykeia amount to 333, of which are standard schools.
- Evening vocational upper secondary schools. Attendance lasts for 3 years (grades A, B and C). These schools are attended either by adult students or underage working students. Evening vocational lykeia amount to 76.
- Model vocational upper secondary schools.
- The Unified Special Vocational Gymnasiums - High Schools
- The Special Vocational Education Workshops (EEEEK)

Organisation of the school year

The organization of the school year for lower and upper secondary education is defined at central level as shown in the following table:

	Lower Secondary Education	**Upper Secondary Education General& Vocational**
School year	1st September – 31st August	
Teaching year	1st September – 30th June	
Lessons duration	11th September – final week of May	
Terms	1st: 11th September – 20th January	
	2nd: 21st January – end of lessons	
	Final exams	

Between 1 and 30 June, schools deliver: The first period of exams, which includes written follow-up revision exams on group A subjects (subjects taught in gymnasia fall under 3 groups according to Presidencial Degree 126/2016, art. 1,2&5 and its modification based on Law 4876/2021, art. 122, par.1). Written exams are carried out

from 1 September until the beginning of classes, for the students that failed to pass successfully the class.
No teaching and exams take place during the Christmas holidays (two weeks), Easter holidays (two weeks) and summer holidays (from 1 July to 31 August). The days of operation of school units are approximately 189 annually. They are organized in weeks of 5 days (Monday to Friday).

Organisation of the school day and week

- **Gymnasio (lower secondary schools)**

The weekly teaching time per class is set at a central level and has universal validity for all day and evening High Schools day and evening upper secondary schools, day and evening vocational upper secondary schools - EPAL in the territory. Classes in daytime high schools start at approximately 08:15 and end at 14:10, while evening classes start at 19:20 and end at 22:55 while in evening EPAL, classes begin at 17:00 or 17:30 or 18:00 or 18:30 and end between 20:50 and 23:00, depending on the alternative scenaria as regards operating times, that they follow. However, the distribution of lessons on a weekly basis is not defined centrally but is a decision of each school unit and is shaped according to its needs.
Remedial teaching classes (M.D. 126316/D2/62021) operate in lower secondary education schools. Remedial education operates every school year and ends when all school classes end, before the beginning of exams. Students can attend the following subjects: Modern Greek Language and Literature, Ancient Greek Language and Literature, Maths, Physics, Chemistry, English Language.

Curriculum, subjects, number of hours

- **Gymnasio (lower secondary schools)**

The number of teaching hours on a weekly basis amount to Curricula are centrally defined. They target all students attending the same grade and education level. Taught time for subjects at day gymnasia is specified according to Mininisterial Decision 94207/D2/2021 (1)). It amounts to 33 hours for grades A and B and to 34 hours for grade C for day secondary schools per week 33 hours for grades A and B and to 34 hours for grade C for day lower secondary schools and to 24 hours for grades A and B and to 25 hours for grade C for evening lower secondary Schools. The schedule of day lower secondary schools is as follows:

Weekly Time Schedule of Junior High school				
Subjects		**Grades**		
		A	**B**	**C**
Modern Greek language and Literature	Language teaching	3	2	2
	Modern Greek Literature	2	2	2
Ancient Greek Language and Literature	Ancient Greek Language	2	2	2
	Translated Ancient Greek texts	2	2	2
Mathematics		4	4	4
Physics		1	2	2
Chemistry		-	1	1
Biology		1	1	1
Geology/Geography		1	2	-
History		2	2	2
Religious Education		2	2	2
English		2	2	2
2nd Foreign Language (French/ German/ Italian)		2	2	2
Social & Civic education		-	-	3
Home economics		1	-	-
Physical Education		2	2	2
Technology and information technology	Technology	1	1	1
	Information technology	2	1	1
Culture activities	Music	1	1	1
	Arts	1	1	1
Skill Development Workshops		1	1	1
Total Hours		33	33	34

Subjects taught in gymnasia are compulsory for all students of the same grade, except for the second foreign language. Students choose a second foreign language, French or German, at grade 5 of primary school. The selection is valid until grade C of lower secondary school.
The teaching unit entitled "Skill Development Workshops" is introduced into the curriculum and the weekly timetable of all types of compulsory education school units, kindergartens, primary and secondary schools Based on Law 4692/2020.
As part of the optional school activities, which take place outside school hours, the following actions are developed by the teachers: Environmental education, Health education, Cultural and artistic subjects.

School laboratories (natural sciences and information technology)

A major effort is made for the promotion of laboratory teaching for the subjects of natural sciences as well as for the support of the teaching and the application of information and new technologies in secondary education schools.

The school laboratory of natural sciences covers the needs of natural sciences laboratory teaching. The implementation of lab activities is an integral part of teaching natural sciences subjects. The school laboratories offer a place for teaching and practical activities. Students work in groups on a specific subject, developing their creativity in a spirit of cooperation. At the same time, they have at their disposal up-to-date instruments, which help students discover the natural environment and the laws that govern it.

The basic function of the school laboratory for information technology and computer applications is to teach computer science and computer applications as defined by the curricula and the greater educational goals. The lab operates complementary to the educational process. It offers a modern and interactive way of learning and training through the teaching of subject fields.

- **Geniko lykeio (upper secondary schools)**

The number of teaching hours is 35 on a weekly basis for day general lykeia and 25 for general evening lykeia.

The curricula for grades A, B and C are defined by Ministerial Decision 94196/D2/2021 currently in effect. The following apply:

General education subjects		**Grades**	
		A´	**B´ General Education Subjects**
Greek Language	Ancient Greek Language and Literature	5	2
	Modern Greek Language and Literature	4	4
Mathematics	Algebra	3	3
	Geometry	2	2
Natural Science	Physics	2	2
	Chemistry	2	2
	Biology	2	2
Religious Education		2	2
History		2	2
Philosophy			2
English		3	2
Second Foreign Language (French or German)		2	1
Physical Education		2	2
Social Education (Economy, Civil Institutions, Law Principles and Sociology)		2	-
Information Technology Applications		2	
Introduction to the principles of IT Applications			2
Total teaching time		35	30

Grade B Group specialisation subjects			
Human Studies Specialization Group	**Hours**	**Science studies specialisation group courses**	**Hours**
Ancient Greek Language and Literature	**3**	Physics	**2**
Latin	**2**	Mathematics	**3**
Total hours for specialization group	**5**	**Total hours for specialization group**	**5**
Total Teaching Time			**35**

The curriculum in Grade C of day general lykeio is split into school subjects of general education and school subjects of specialisation taught 32 hours per week. There are 3 specialisation groups:

1. Human studies
2. Sciences and Health studies
3. Economics and IT.

Students are required to select subjects of their specialisation group along with general education subjects. Students specializing in Sciences and Human studies are required to select either Mathematics or Biology.

Grade C - General education subjects	Hours
Religious Education	1
Modern Greek Language and Literature	6 (5hrs for the main school subject and 1 hour on answering questions posed, recapitulation etc)
History (it is taught to students who opt for the Science Studies and Health Studies Specialization group as well as the Economics and Information Technology Studies specialization group)	2
Mathematics (it is taught to students opting for Human studies specialization group)	2
English	2
Physical Education	2
Total hours for general education	**14**

Grade C - Groups Specialization Subjects					
Human Studies Specialization Group	**Hours**	**Sciences and Health studies group**	**Hours**	**Economics and Information Technology group**	**Hours**
Ancient Greek	6	Mathematics (for students opting for the second Discipline) or Biology (for students opting for the third discipine)	6	Mathematics	6
History	6	Physics	6	Information Technology	6
Latin	6	Chemistry	6	Ecomomics	6
Total hours for the specialization group	18	**Total hours for the specialization group**	18	**Total hours for the specialization group**	18
Overall total of hours					32

 Epangelmatika lykeia (vocational upper secondary schools - EPAL)

Teaching time amounts to 35 hours per week for day EPAL and 30 for evening EPAL.

Grade A

The curriculum for **EPAL grade A** includes:

- **General education subjects** common to all students
- **Specialisation subjects** and
- **Elective subjects**.

Instruction time for general education subjects, orientation subjects and elective subjects administered at day EPAL grade A, are specified by Ministerial Decision F2/92271/2018.

Instruction time for day EPAL grade A subjects

General education subjects			
	Subjects		**Hours**
1	Modern Greek		4
2	Mathematics*1	Algebra	3
		Geometry	1
3	Natural Sciences*2	Physics	2
		Chemistry	1
		Biology	1
4	Civic Education - (breaks down into the subjects of Economy, Political Institutions and Sociology and Principles of Law)		2
5	History		1
6	Religious Education		1
7	Foreign Language (English)		2
8	Physical Education		2
9	IT*3		2
Total			**22**

Specialisation subjects		
	Subjects	**Hours**
1	Research Project in Technology*3	2
2	Career Guidance in Schools - Health & Safety in the Workplace	3
3	Creative Activities Zone	2
Total		***7***

Elective subjects *4		
	Subjects	**Hours**
1	Health Education	2
2	Introduction to Linear and Architectural Drawing	2
3	Introduction to Electrical & Electronic Engineering	2
4	Introduction to Mechanical Engineering	2
5	Introduction to Economics	2
6	Introduction to Composition	2
7	Agriculture and Sustainable Development	2
8	Shipping	2
Total		***6***

*1 Mathematics: subject is split into: a) Algebra and b) Geometry
*2 Natural Sciences subject is split into: a) Physics, b) Chemistry and c) Biology
*3 When the number of students per classroom is more than 16, classroom is divided into two (2) groups. IT and Research Project in Technology are taught alternately for two (2) hours per week
*4 Students have to choose 3 among 8 available subjects, depending on the departments operating within the EPAL.

Grade B

Sectors of studies are set up for EPAL grade B; in grade C these are subdivided into separate specialisations. Students who enrol in grade B apply for the sector they wish to follow.

Therefore, the curriculum includes:

- 12 hours General education subjects offered to all students and
- 13 hours Technological-vocational subjects per sector.

The curricula for general education and technological-vocational subjectsper sector administered in day EPAL grade B, are specified by Ministerial Decision F2/92271/D4/2018. According to the new programme of studies and under Ministerial Decision F20/82041/D4/2016, 9 sectors are set up for EPAL grade B.

Grade C

During their enrolment in grade C students can apply for any specialisation of the sector that they attended in grade B. The sectors and the respective specialisations are defined by Ministerial Decision F20/82041/D4/2016.

Laboratory centres operate in an independent administrative structure as school units and are in cooperation with the respective vocational schools of their area. EPAL, IEK and Vocational Training Schools (ESK). They are formed by at least two school units, including public vocational ESK or IEKS. Laboratory centres consist of specially designed premises with equipment of various fields or specialties, where the lab practice of EPAL students takes place. Post-secondary year-apprenticeship class students also practice in Labs, in order to meet the requirements of the curricula.

The school laboratory of natural sciences (SEFE) is the place where natural sciences laboratory teaching takes place. The implementation of lab activities is an integral part of teaching natural sciences subjects.

The laboratory of the vocational upper secondary school is modern and it can function both as a place for teaching and as a place for practice and activities.

Assessment

- **Gymnasio (lower secondary schools)**

Subjects taught in gymnasia fall under 3 groups: in **Group A Subjects** only one hour-long written test is conducted during the first four months. In **Group B Subjects**, one hour-long written test is conducted during the first semester and one during the second semester. During the second quarter, the teacher of the course of the second group may choose, instead of conducting an hour-long written test in a department or departments, to assign a short synthetic creative work to the students of the department or departments. In the Group C Subjects, there is no hour-long written test. According to (Presidential Decree 126/2016, art. 1,2&5) and its modification based on(Law 4876/2021, art. 122, par..1) Presidential Decree 126/2016:

The first group (group A) includes amongst others the following subjects that concern STEM:

- Mathematics
- Physics
- Biology

The second group (group B) includes the following subjects that concern STEM:

- Geology-Geography
- Chemistry
- Technology – IT

The third group (group C) includes the following subjects that concern STEM:

- Skill development workshops

- **Geniko lykeio (upper secondary schools)**

According to law 4547/2018, attendance in day and evening lykeio is 3 years. It includes grades A, B and C.

Day and evening general lykeio Grade A subjects are divided into two (2) groups (M.D. 102474/D2/2021):

- **Group A** includes general education subjects tested through written exams. The ones that concern STEM are the following:

1. Mathematics (Algebra and Geometry)
2. Natural Sciences (Physics and Chemistry)

- **Group B** includes all other general education subjects not tested through written exams, in which the following subject is included:
- Information Technology Applications.

Day and evening general lykeio Grade B subjects are divided into two (2) groups:

- **Group A** includes general education subjects tested through written exams. The ones that concern STEM are the following:

1. Natural Sciences (Biology)
2. Mathematics (Algebra and Geometry)

In addition to the above subjects, Group A also includes **specialization group subjects.**

- **Group B** includes all other general education subjects not tested through written exams, among which are the following:
- Physics
- Chemistry
- Introduction to the principles of IT Applications

Day general lykeio Grade C subjects and evening general lykeio. Grade C subjects are divided into two (2) groups:

- **Group A** includes the general education school subjects and all the Specialization Groups school subjects that are tested through the written school-leaving exams.
- **Group B** includes the rest of the general education that are not tested through the written school-leaving exams.

Epangelmatika lykeia (vocational upper secondary schools - EPAL)

As far as the format of progression, graduate and degree exams, since school year 2018/19, subjects or subject fields are characterised as:

- Tested through written exams
- Not tested through written exams

Due to the special circumstances caused by the coronavirus pandemic, during the school year 2019-2020, the Ministerial Decision F4/53112/D4/2020 was issued and validated for the students' assessment. For school year 2020-21 Ministerial Decision F5/55515/D4/2021 determines the conditions of student assessment during terms, exam periods and degree exams for student progression.

Assessment of student performance during school terms

Gymnasio (lower secondary schools)

Criteria for the assessment of students' performance during school terms are as follows:

- Classroom participation.
- Individual and group work assigned at school or as homework.
- Individual or group multidisciplinary and interdisciplinary tasks.
- One-hour written tests in class.
- Brief tests

At the end of each school term, schools deliver written revision tests on Group A subjects.

Geniko lykeio (upper secondary schools)

The assessment combines various forms and techniques. (Law 4610/2019, Part E΄, Un. B).

For the assessment of the student every quarter, the following criteria are taken into account:

1. Classroom participation
2. Enthusiasm and interest for the subject concerned
3. Performance in written classroom tests lasting either a few minutes or an hour. In all General upper secondary school grades two (2) assessment tests are administered on all the Group subjects, one (1) during the first quarter and one (1) during the second quarter respectively, except for the subject of Physical Education where no assessment test is carried out.
4. Homework or school exercises
5. Comparative/creative projects assigned for the subject concerned. They count towards positive student performance achieved during the respective quarter.

In general lykeio, written progression and school-leaving classroom exams are conducted at the end of the programme taught during the 2nd quarter for the sublects of group A.

It is pointed out that according to Law 4692/2020, for the written courses in the 1st and 2nd grade Lyceum promotion exams and in the 3rd grade Lyceum graduation exams, the exam topics are set at a percentage of fifty percent (50%) by random selection from the Subject Bank of Graded Difficulty (TTDDD) and at a rate of fifty percent (50%) by the teacher or teachers of the corresponding course during the school year.

- **Epangelmatika lykeia (vocational upper secondary schools - EPAL)**

Student assessment during quarters (oral performance)

For the assessment of the student every term, the following criteria are taken into account:

1. Their participation in the educational process
2. The oral examination, as well as their diligence and interest in this specific course.
3. Their performance in the intermediate written and oral tests, and the four-month evaluation tests (article 120 of law 4610/2019, as in force).
4. The assignments are prepared at home or school.
5. The optional creative assignments of students on a voluntary basis.
6. The pupil's portfolio - where it is observed - which may contain data contributing to the comprehensive educational assessment of pupils, that do not arise from other evaluation procedures of their performance.

Written progression and school-leaving follow-up exams

A "classified difficulty exam questions bank" for the student assessment for the promotion for the students of Grade A and Grade B of the Day and Evening EPAL schools is going to be implemented for the school year 2021-2022 and on (Ministeral Decisions F4 / 116552 / CD4 /2021 and F4 / 141050 / CD4 /2021).

Implementation of STEM in the Curriculum through different approaches of assessment

In the context of the evaluation of the students in secondary education, the ministry proposes, among others, the assignment of preparing individual or group multidisciplinary and interdisciplinary tasks in high school or Synthetic Creative Projects in upper secondary education. The Synthetic Creative Projects could even be prepared as an alternative to the one-hour written test of the second quarter in group B courses.

Through these tasks, students can actually deal with STEM applications in the context of technology, ICT, natural sciences and mathematics on their own under the guidance and supervision of their teacher.

Skills Development Workshops

In the 2020-2021 school year, the new curriculum of the teaching unit "Skills Development Workshops" was piloted (M.D. 94236/CD4/2021) in a limited number of kindergartens, primary schools and high schools in the country. From the 2021-2022 school year, the Skills Workshops are universally implemented in all kindergartens, elementary and high schools in the country.

The program and educational material of the "Skills Workshops" are grouped into four (4) Thematic Units, which pertain to the subject shown in the diagram below:

The following program must be followed in terms of the subjects mentioned in each class and grade.

`	Kindergarten	Primary school						High school		
		1st	2nd	3rd	4th	5th	6th	A	B	C
1. LIVE BETTER										
1. HEALTH: Nutrition Self-Care, Road Safety	X	X			X			X		
2. Mental and Emotional Health - Prevention			X			X				X-SVG*
3. I know my body - Sex Education				X			X		X	
2. TAKE CARE OF THE ENVIRONMENT										
1. Ecology - Global and local Natural Heritage	X	X			X			X		
2. Natural Disasters, Civil protection			X			X			X	
3. Global & local Cultural Heritage				X			X			X-SVG
3. BE INTERESTED AND ACTIVE - Social Awareness & Responsibility										
1. Human Rights	X	X			X			X		
2. Voluntary mediation			X			X			X	
3. Inclusion: Mutual respect, diversity				X			X			X-SVG
4. CREATE & INNOVATE - Creative Thinking & Initiative										
1. STEM- Educational Robotics	X	X			X	X		X	X	
2. Entrepreneurship - Career Education - Familiarity with professions			X	X			X			X-SVG

*School Vocational Guidance

Indicative activities: constructions, presentations, games, creating games, theater play, organizing a research or interview, participating in educational radio or educational television, laboratory creation of a virtual business, meeting and interviewing a professional or personality and organizing events.

Weekly Schedule

For the implementation of the subsection STEM & Robotics (which is part of the section CREATE & INNOVATE - Creative Thinking & Initiative):

● In **Kindergarten**, three (3) teaching hours are available, distributed two (2) to three (3) times a week for a total of fifteen teaching hours hours devoted to "Organized Activities and investigations based on the DEPPS-APS" weekly.

● In **Primary school**, 5 to 7 weeks are available in the 1st Primary (i.e. 15-21 teaching hours per year), 5 to 7 weeks in the 4th Primary (i.e. 10-14 teaching hours per year) and 5 to 7 weeks in the 5th grade (i.e. 5-7 teaching hours per year).

● In **High School**, 5 to 7 weeks are available only in A and B High School. That is, 5-7 teaching hours available for STEM activities throughout the school year, only in A and B High School.

Implementation Assignments

With reference to the specialties to which the preparation of STEM activities is assigned and their relevance to the subject of STEM, the following emerges: a) the implementation of the Skills Workshops in the **Kindergarten** is organized, coordinated and taught by the teachers of PE60 Kindergarten. b) In the **Elementary School**, the implementation of the Skills Workshops is organized, coordinated and taught with priority by the teachers of the PE 70 Teachers branch and then by the teachers of all specialties who serve in the school unit. c) Finally, in the **Middle School**, the implementation of the Skills Workshops (M.D. 85980/D2/03-07-2020) is organized, coordinated and taught by 1st Assignment (with priority) mainly by arts teachers and teachers with engineering degrees, as well as IT teachers, gymnasts, economists, sociologists, agronomists and nutritionists. While with B assignment, all the other teacher specialties are undertaken (e.g. philologists, theologians, mathematicians, physicists, chemists, biologists, foreign language teachers).

Evaluation of Students

Skills Development Workshops are not evaluated in the traditional way, but emphasis is placed on descriptive evaluation and the writing of a portfolio by the student.

School Educational Clubs

According to the M.D. 102939/CD4/2022 the Principals or Heads of primary schools and Secondary Education units, may decide on the formation and operation of School Educational Clubs, after the end of the daily teaching schedule. The school educational clubs of primary schools may be formed and operate during the teaching hours of the school unit's all-day program.

In elementary schools, middle schools and high schools, it is possible to set up school educational clubs, which operate after the end of the daily teaching schedule. However, educational clubs of elementary schools may be formed and operate during the teaching hours of the school unit's full-day program and more specifically in the third (3rd) zone of the new upgraded program of the full-day Primary School, for a continuous two hours every day, with a break of a few minutes in between. The clubs run once or twice a week. The minimum weekly hours of operation of a club are two (2) teaching hours and the maximum four (4) teaching hours. The operation of a club is considered sufficient if a minimum of thirty-six (36) hours are carried out per year, for clubs with a two-hour weekly operation, and seventy-two (72), for clubs with a four-hour weekly operation.

In the context of the operation of the clubs, a variety of different objects and actions can be offered, among which educational robotics, as well as scientific constructions - experiments, which can include STEM activities and games. The clubs, depending on their content and objectives, may be offered to students of one or more classes. Each student can participate in one or two clubs.

The minimum number of students for the operation of a club is set at six (6) and the maximum at twelve (12), although this can be varied with a documented recommendation of the teacher in charge and decision of the Director or the Head of the school unit.

In each club, up to two (2) teachers, of independent specialty, have the right to participate, while each teacher can be selected and designated as the person in charge of a single club. It is noted that the time that the managers of the educational groups dedicate to the organization and operation of these groups is not counted in their working hours, but is taken into account during their individual evaluation, as well as during their selection as education executives.

PROGRAMS OF SCHOOL ACTIVITIES

In the context of education for sustainability, sustainable development and the environment, School Activities Programs are designed, organized and implemented by teachers and students of the country's school units, for which the following apply (Circular M.Ed.R.A., F11/126281/D7/14-10-2022):

The PSA implemented in the Primary and Secondary Education units of all types last at least three (3) months and are implemented at any time during the academic year and up to ten (10) days before the end of the lessons.

The School Activities Programs are implemented:

• in Primary Education within program hours,

• in Secondary Education outside of program hours, with the exception of EPAL students who take part in school activities within the Creative Activities Zone in the 1st EPAL. In addition, in this zone, ST(R)E(A)M activities can be carried out with the support of the Groups, enhancing the development of 21st century skills of the students.

Each Primary or Secondary Education teacher can implement up to three (3) Programs, in one of which he can be designated as Coordinator. A total of three (3) teachers participate in each Program.

In Secondary Education school units, a two-hour session is defined weekly for each Program, which is recorded in the minutes of the school's Teachers' Association.

It should be noted that for all the mentioned Programs, teachers are not expected to complete teaching hours.

In Primary and Secondary Education units, each student can participate in up to two (2) PSAs.

The P.S.A. are related to environmental education, health education, cultural issues and career education. In general, they deal with social and cultural issues, which are of particular concern to local communities and need to be resolved in accordance with the principles of sustainability. They derive their thematic content mainly from these issues and it is sought, as far as possible, to contribute to the successful treatment and rational management of environmental and other problems. Exploring possible solutions to the issues dealt with, can be done through the implementation of STEM perspective.

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2.5. ITALY

The Italian system of education and training is organised in accordance with the principles of subsidiarity and the autonomy of educational institutions. The State has exclusive legislative competence with regard to "general rules on education", the determination of the essential levels of performance that must be guaranteed throughout the national territory and the fundamental principles that the regions must respect in the exercise of their competences. The regions have the concurrent legislative power in the field of education, and exclusive in the field of education and vocational training. Schools have autonomy in teaching, organization and research, experimentation and development.

Miur is responsible for the administration of the education system at the central level; it operates through the Regional School Offices (Usr), which in turn are divided into the territorial ambits at the provincial level.

School autonomy is exercised within a general frame of reference established by the Miur, so as to ensure the unified character of the education system. In fact, it is the Ministry that defines the general objectives of the educational process, the specific learning objectives related to pupils' competencies, the disciplines of the curricula and their relative annual amount of hours, the total annual compulsory hours of the curricula, the standards related to the quality of the service, the general guidelines about the evaluation of pupils, the recognition of credits and educational debts, and the general criteria for the organization of training paths aimed at adult education.

Compulsory schooling lasts ten years, from age 6 to 16, and includes the eight years of the first cycle of education (five years of elementary school and three years of secondary school) and the first two years of the second cycle, which can be done in the state-run secondary school (lycées, technical institutes and vocational institutes), or in the vocational education and training pathways under regional jurisdiction.

Parents of pupils are responsible for the fulfillment of their children's educational obligation, while supervision of the fulfillment of the obligation is provided by the municipalities of residence and the headmasters of schools where pupils are enrolled.

PUPILS WITH DISABILITIES

Law 104/92 aims to ensure full respect for the dignity of the person with a disability, his or her rights to freedom and autonomy, through full integration in the family, school, work and society. It defines as a beneficiary the person who has a physical, mental or sensory impairment, which is the cause of learning, relationship or work integration difficulties. It promotes school integration as the goal of developing the person's potential.

School integration of pupils with disabilities is a strength of the Italian school, which aims to be a welcoming community in which all pupils, regardless of their functional diversity, can realize individual and social growth experiences. MIUR implements various accompanying measures to foster integration: support teachers, funding of projects and activities for integration, training initiatives for support and curricular teaching staff as well as administrative, technical and auxiliary staff.

In Italy paritarian schools are qualified to award degrees that have the same legal value as those of the corresponding state schools.

The constitutional principle of freedom of education finds realization throughout the country through state and non-state schools. In fact, Article 33 of the Constitution allows entities and private individuals to establish schools and educational institutions. Such schools, defined as non-state, may be:

-paritarian (recognized under Law 62 of March 10, 2000)

-non-parity (Decree Law 250 of December 5, 2005, converted by Law 27 of February 3, 2006)

-foreign (Presidential Decree 389 of April 18, 1994)
They perform a public service. Recognition of equality therefore guarantees:
- the equality of students' rights and duties
- the same arrangements for the conduct of state examinations
- the fulfillment of compulsory education
- the qualification to issue degrees having the same legal value from state schools

The educational system is currently organized as follows:

INFANT SCHOOL

The attending of this school is not obligatory (parents can decide to register their children in accordance with the needs), Institutions offering preschool education may be run not only by the state, but also by municipalities and private entities. Preschools contribute to the education and affective, psychomotor, cognitive, moral, religious and social development of girls and boys by promoting their potential for relationships, autonomy, creativity, learning, and to ensure effective equality of educational opportunities. While respecting the primary educational responsibility of parents, it contributes to the integral formation of girls and boys and, in its educational and pedagogical autonomy and unity, realizes the educational profile and educational continuity with preschool and elementary school services.
and it’s divided into:
– asilo nido (kindergarten): attended by 0-to-3 years old children
– scuola materna (preschool): attended by 3-to-6 years old children

Although part of the same system, educational services for the range 0-3 are organized by the Regions on the basis of individual regional laws. Children’s school for the 3-6 age group is, however, under the responsibility of the Ministry of Education.
From 6 to 16 years of age, attending school becomes obligatory, as established by the law, and we enter the so-called scuola dell’obbligo (compulsory education), Compulsory education can be provided in both state and private schools. In addition, everyone has the right/duty to train for at least 12 years within the education and training system or until a student has acquired a professional qualification within the eighteenth year of age. Compulsory education starts with:

PRIMARY OR ELEMENTARY SCHOOL (5 years) for children from 6 to 11 years
The duration of elementary school is 5 years; it is attended by students aged 6 to 11. During these years, boys and girls learn to write and read, and they learn the basics of History, Geography, Mathematics, Italian Grammar, Science, Music and Physical Education, English and Computer Science while Religion classes are optional. Elementary school aims, in addition to simple literacy, to promote the development of each pupil's personality, to make them acquire and develop basic knowledge and skills, including those of computer literacy, to make them learn the means of expression, the Italian language and the English language, to lay the foundations for the use of scientific methodologies in the study of the natural world, to enhance interpersonal skills and to educate them in the basic principles of civil coexistence.

LOWER SECONDARY SCHOOL (3 years) for pupils aged 11 to 14
The secondary school, through the disciplines,
- stimulates the growth of autonomous study and social interaction skills
- organizes and enhances knowledge and skills, also in relation to cultural tradition and the social, cultural and scientific evolution of contemporary reality
- progressively develops skills and abilities of choice corresponding to the aptitudes and vocations of the students
- provides adequate tools for the continuation of education and training activities

- introduces the study of a second language of the European Union
- helps orientation for the subsequent choice of education and training (Law 53 of 2003).

The subjects that are studied are:
Italian (5 hours per week), History and Geography (with Citizenship and Constitution) (4 hours), in-depth study in literary subjects (1 hour), Mathematics (4 hours), Science (2 hours), Technology (2 hours), English Language (3 hours), Second Community Language (2 hours), Art and Image (2 hours), Music (2 hours), Motor and Sports Sciences (2 hours), Catholic Religion or alternative activity (1 hour).
In addition, the student and families can choose up to a maximum of 4 hours of optional workshops, which each school can offer based on the staff resources available to it.
There is also an experimental music course in which pupils can study a musical instrument. The activities planned for the music-oriented pathways (instrumental lesson, in individual and group teaching modes; music theory and reading; ensemble music) take place in additional hours to the scheduled time frame
At the end of the third year, pupils must pass a State Examination in order to be admitted to the second cycle of education. The title that is awarded is a Baccalaureate Diploma.

The second cycle of education consists of two types of courses:
Upper Secondary school which is a competence of the central state, lasting 5 years, addressed to pupils from 14 to 19 years. Three-year and four-year ***vocational education and training*** (VET) courses, in this type of school, students acquire practical and professional skills.
Thus, Italian students can choose between two types of high schools, depending on their goals:
(a) Liceo: offers a more theoretical education and is more oriented toward further study at university, and depending on the subjects studied, they can be of different types:

CLASSICAL LYCEUM

The Liceo Classico is the oldest course of study and until 1969 it was the only upper secondary school that gave access to any university faculty: this privilege meant that for a long time the Liceo Classico accommodated students from the better educated or wealthier classes.
The path of the Liceo Classico is directed toward the study of classical civilization and humanistic culture. In fact, in this educational address, the teaching of classical languages and cultures is compulsory, but there are hours devoted mainly to humanistic subjects, such as history, philosophy and literary subjects in general, for example, art history. However, at the classical high school, science-mathematics subjects, such as mathematics, natural sciences and physics, are also studied.
In addition, there are all those other subjects common to all secondary schools, such as, for example, English, exercise and sports science, Catholic religion (which, however, is optional).

SCIENTIFIC LYCEUM

The scientific high school integrates the humanities and arts subjects typical of the classical high school (excluding ancient Greek) with an increased focus on mathematics and natural sciences. The scientific high school includes the teaching of Italian, history, geography, philosophy, English and art history; but also the in-depth study of scientific subjects such as mathematics, physics, and natural sciences; there is also the teaching of geometric and architectural drawing.
The latest reform created a new address, the applied sciences option, which, compared to the traditional scientific high school, includes a reduction in the number of hours devoted to humanities subjects, the elimination of Latin replaced by computer science, and a further increase in science subjects, part of which are in the laboratory.
In some institutions, an experimental enhancement-orientation pathway is active, which provides, starting in the third grade, the introduction of the discipline Biology with a biomedical bent. This three-year pathway allows students to acquire skills in the biological field, thanks also to laboratory

practices, which help students who are interested in pursuing studies in the chemical-biological and health fields.

HUMANITIES HIGH SCHOOL

The humanities high school pathway is directed toward the study of explanatory theories of phenomena related to the construction of personal identity and human and social relations. It guides the student to deepen and develop knowledge and skills and to mature the competencies necessary to grasp the complexity and specificity of educational processes. This course of study ensures mastery of the languages, methodologies and techniques of inquiry in the humanities. The curriculum of this high school urges students to compare different theories and reflect on various aspects of social reality, dwelling with particular attention on educational phenomena and training processes, places and practices of education, personal services, the world of work and intercultural phenomena.
At the conclusion of the educational pathway, in addition to the achievement of the learning outcomes common to all high school profiles, they will have matured the ability to orient themselves competently in the main areas of investigation of the human sciences, making use of the contributions, both specific and interdisciplinary, of pedagogy, psychology and socio-anthropological culture. The subjects covered in the course are Italian, Latin, History, Geography, Philosophy , Humanities i.e. Anthropology, Pedagogy, Psychology and Sociology, Law and Economics, Foreign Language and Culture, Mathematics with Computer Science in the first two years, Physics Natural Sciences i.e. Biology, Chemistry, Earth Sciences, Art History, Exercise and Sports Sciences, Catholic Religion or Alternative Activities
- The Economic-Social Option
As part of the regional planning of educational offerings, the Economic-Social Option may be activated, which provides particularly advanced skills in studies involving the legal, economic and social sciences. In fact, this high school address is centered on legal, economic and social disciplines.

LINGUISTIC HIGH SCHOOL

The language high school curriculum is directed toward the study of multiple language and cultural systems. It guides the student to deepen and develop knowledge and skills, to mature the competencies necessary to acquire communicative mastery of three foreign languages and cultures and to critically understand the historical and cultural identity of different traditions and civilizations. English language is usually studied as "Foreign Language and Culture 1." The other two foreign languages can be European or non-European (language offerings vary by educational institution). The foreign languages that can be activated in public institutions are Arabic, Chinese, Hebrew, French, Japanese, Russian, Slovenian, Spanish, and German. In recent years, more and more educational institutions have chosen to activate one or more non-European languages.
It also maintains the framework of typical high school subjects (Italian, Latin, foreign language, history and geography, mathematics, physics, natural sciences and art history).

ART SCHOOL

The path of the artistic high school is directed toward the study of aesthetic phenomena and artistic practice. It fosters the acquisition of the specific methods of artistic research and production and the mastery of related languages and techniques.
This address is also characterized by the presence of workshops, in which students develop their design skills:
✔the laboratory of figuration, in which the student acquires a develops mastery of the
✔the architectural laboratory, in which the student acquires mastery of methods of representation specific to architecture and urban planning;

✔the multimedia laboratory, in which the student acquires and develops mastery of the languages and techniques of multimedia communication;
✔the design laboratory, articulated in the individual areas of artistic production, in which the student acquires the methodologies proper to the design of objects;
✔ the graphic design and fashion laboratories, in which the student acquires mastery of the methodologies of these disciplines.

MUSICAL HIGH SCHOOL

The path of the high school of music and dance "is addressed to the technical-practical learning of music and dance and the study of their role in history and culture." The course of study is characterized by a high school-type approach to the various disciplines in order to give the student a solid basic cultural preparation. Musical training is thus accompanied by the study of scientific subjects and the overall cultural formation given by humanistic disciplines such as history, Italian literature, and geography, which go to enrich the student's cultural horizon.

TECHNICAL INSTITUTES offer a solid cultural base of a scientific and technological nature. At the same time, they foster the development of skills that allow immediate entry into the world of work (in a business or self-employment). With the Technical Institute diploma, it is possible to continue studies at university, especially in scientific-technological and economic degree programs, or to specialize further at Higher Technical Institutes.
Technical Institutes include two sectors: business and technology. These are addresses also designed for the world of work, which seeks skilled technicians. Each of these sectors has different addresses
ECONOMIC SECTOR

1.ADMINISTRATION, FINANCE AND MARKETING

This course of study fundamentally develops professionalizing skills in the fields of business and economics and law, complemented by cross-curricular language and computer skills.
In particular, the skills of the professional field cover: national and international economic-business phenomena, civil and tax law, business systems, marketing tools, insurance/financial products, social and political economy.

2. TOURISM

The Graduate in Tourism has specific skills in the business sector of the tourism industry and general skills in the field of national and international economic macro phenomena, civil and fiscal regulations, and business systems. Intervenes in the integrated and sustainable enhancement of cultural, artistic, craft, food and wine, landscape and environmental heritage. Integrates the skills of the specific professional field with linguistic and computer skills in order to operate in the company's information system and contribute to both innovation and organizational and technological improvement of the tourism enterprise inserted in the international context.

3.TECHNOLOGY SECTOR

1.**Mechanics, Mechatronics and Energy**
Aims to train professionals capable of designing and building mechanical and electromechanical systems. All in compliance with industry regulations
2.**Transportation and Logistics**
Enables in-depth study of the construction and operation of naval, land and air transportation systems, in compliance with national, EU and international standards
3.**Electronics and Electrical Engineering**
Teaches understanding of the fields of electronics, robotics applied to production processes and industrial automation
4.**Computer Science and Telecommunications**
Allows you to enter the world of communications and information technology and understand its regulations and the technologies used

5.**Graphics and Communication**
Allows you to enter the world of communication, personal and mass, and understand how it develops through graphics, multimedia languages and new technologies
6.**Chemistry, Materials and Biotechnology**
Allows students to learn how to manage chemical-biological processes to be adopted in the research, pharmaceutical, food, environmental, dyeing and leather processing sectors. With a focus on environmental protection and health

FASHION SYSTEM

Prepares fashion professionals to conceptualize, design, manufacture and promote textile, apparel and footwear products
2.**Agriculture, Food and Agribusiness**
Teaches how to manage the production and processing processes of agricultural, agribusiness and agroindustrial products by combining tradition and technological innovation
3.**Construction, Environment and Land Use**
Prepares those who want to enter the field of building, construction, environmental protection and safety in the workplace

The paths of **vocational institutes** contribute to the formation of the person in the "knowledge society" and tend to enhance him or her, essentially, in his or her working role.
They are characterized, therefore, by an integration between technical-professional knowledge and linguistic and historical-social knowledge that allows students to acquire cultural, scientific, technical and operational skills, abilities and knowledge typical of professional figures at the intermediate level and necessary to assume technical operational roles in the area of economic activities of reference.
Vocational Education courses include a two-year unitary course and a three-year course aimed at deepening the student's education according to the specific address. Vocational Institutes are characterized by eleven courses of study:
a. Agriculture, rural development, enhancement of local products and management of forest and mountain resources;
b. Commercial fishing and fish production (newly introduced);
c. Industry and handicrafts for Made in Italy;
d. Maintenance and technical assistance;
e. Water management and environmental remediation (newly introduced);
f. Commercial services;
g. Food and wine and hotel hospitality;
h. Cultural and entertainment services (newly introduced);
i. Health and social work services;
j. Auxiliary arts of health professions: dental technician;
k. Auxiliary arts of health professions: optician.
At the end of secondary school, students who pass the final state exam are awarded a diploma that provides access to higher education.
The final state examination consists of three tests.
The first consists of a national written test of the Italian language or of the different language in which the teaching takes place. The second is a written test on the target discipline indicated by the Ministry of Education. The third test consists of a multidisciplinary interview.
The final evaluation is expressed in hundredths. The school credit earned in the last three years of high school is added to the score of the written tests and the interview. A candidate who achieves the highest score in both the credit and the examination tests may be awarded honors.

Higher education

- Universities (including polytechnics)
- Institutes of Higher Education in Art, Music and Choreography (Afam)
- Higher schools for language mediators (SSML)
- Higher Technical Institutes (ITS)

The university is the primary seat of free research and free education within its system and is a place of learning and critical elaboration of knowledge; it operates, inspired by the principle of autonomy and responsibility, organically combining research and teaching, for the cultural, civil and economic progress of the Republic (Law 240/2010, art1, paragraph 1 and 2).

In Italy there have been various phases of reform of the university system, with the aim of making the structure, organization and university regulations increasingly responsive to needs posed not only by strictly educational purposes, but also of effective connection with the various sectors of work, in harmony with the directives and orientations of EU policies.

The Italian system is composed of a total of:

97 university institutions of which 67 are State Universities

19 legally recognized non-state universities

11 legally recognized non-state telematic universities

Courses and Academic Degrees

Courses and academic degrees under the current regulations are divided according to precise categories:

- **The Bachelor's Degree Course** represents the first level of university education. Its objective is to ensure that the student has an adequate mastery of general scientific methods and content, even when oriented toward the acquisition of specific professional knowledge.

The required entry qualification is a five-year secondary school (high school) diploma. The academic title awarded at the end of the three-year course is the Laurea degree.

- **The Master's Degree Course** is at the second level of university education. It aims to provide the student with an advanced level of education for the pursuit of highly qualified activities in specific fields. The planned duration of the course is 2 years.

The admission qualification is the bachelor's degree. The degree is obtained by taking 120 credits and passing a final examination. The academic qualification awarded is the Master's Degree.

- **The single-cycle Bachelor's** degree program is precisely characterized by an overall duration fixed at 5 or 6 years. This category includes courses of study that, in line with European Union regulations, do not include the possibility of three-year degree programs. The courses of Medicine and Surgery, Dentistry and Dental Prosthetics, Veterinary Medicine, Pharmacy, Chemistry and Pharmaceutical Technology (Ctf), EU Architecture and Construction Engineering-Architecture, and Law fall into this group, also known as the unit-path master's degrees.

For this type of course, the required admission qualification is a five-year secondary school (high school) diploma. The academic qualification awarded is the Master's degree.

- **The University Master's Degree** is divided into two different types: the First Level University Master's Degree, which has a total duration of 1 year and requires as an admission qualification a Bachelor's Degree, and the Second Level University Master's Degree, for which a Master's or Specialist Degree is required. This category includes Courses of Scientific Perfection and Continuing and Recurrent Higher Education, which follow the award of a Bachelor's or Master's degree.

- **The Specialization Course** aims to provide the student with knowledge and skills to carry out particular professional activities and can be established only in application of specific legal regulations or European Union directions. Its duration is defined by course regulations or European directives. It covers courses of study pertaining to medical specialties, legal professions, secondary school teacher training. To be admitted to a Postgraduate Course, it is necessary to hold at least a Bachelor's Degree; the title awarded is Specialist.

- **The Ph.D. program** has a duration of 3 or 4 years. As of the academic year 1999/2000, Ph.D.s are established and announced by universities and colleges in their full organizational, teaching and scientific autonomy. The admission qualification to enter them is the Master's Degree. The title awarded is that of PhD.

THE INSTITUTIONS HIGHER EDUCATION IN ART AND MUSIC (AFAM)

AFAM institutions offer a wide range of courses in the arts in the areas of visual arts, music, dance, drama and design.
These institutions are divided into:

- Academies of Fine Arts (state and legally recognized)
- Higher Institutes of Design (ISIA)
- State Music Conservatories
- Higher Institutes of Musical Studies
- National Academies of Dance
- National Academies of Dramatic Art.

The AFAM system is composed of a total of 145 institutions, 82 of which are state-run and 63 non-state-run, namely: twenty state-run Fine Arts Academies; one National Academy of Dramatic Art; one National Academy of Dance; 55 state-run Music Conservatories; 18 former Music Institutes of equal status; five Higher Institutes for Artistic Industries; eighteen legally recognized Fine Arts Academies, including the five historical ones in Genoa, Verona, Perugia, Bergamo, and Ravenna; and 27 other Institutes authorized to grant degrees with legal value.
The AFAM system is organized into three different cycles:
First cycle
Includes courses in the "First Level Academic Diploma" which aims to provide students with a mastery of artistic methods and techniques, eventually acquiring specific professional skills in the field.
Second cycle
Concerns courses related to the "Second Level Academic Diploma" which aims to provide students with an advanced level of training that enables them to achieve full mastery of artistic methods and techniques, finally acquiring specific and highly qualified professional skills in the field.
Third cycle
Includes courses related to the "Academic Diploma in Research Training," which aim to provide the necessary skills for research activities.
Higher education degrees in art and music have legal value equivalent to university degrees. At state music conservatories, non-state music institutes and the Academy of Dance, courses of study at the pre-academic level are also active.

ITS are schools of excellence with a high technological specialization that enable students to obtain a higher technical diploma.
are two-year courses that run in parallel with the university system and enable students to acquire knowledge, skills and competencies to work in cutting-edge contexts because they are also designed together with companies.
ITS, in fact, are implemented by Foundations that collaborate with businesses, universities, scientific and technological research centers, local authorities, and the education and training system, ensuring

a strong link with the world of work so as to meet the demand for the professional figures most in demand and truly needed by businesses.

ITS courses are divided into 6 nationally defined areas that are considered strategic for the development of our country:

- Energy efficiency
- Sustainable mobility
- New technologies of life
- New technologies for Made in Italy
- Innovative technologies for cultural goods and activities - Tourism
- Information and communication technologies

ADULT EDUCATION

In our country, adult education was defined rather late in terms of legislation, but it has been able to offer significant responses to the population's need for culture in a short time, mainly through the dissemination of experiences and good practices that in recent years have achieved a "de facto system."Adult education include all activities aimed at cultural enrichment, retraining and professional mobility of adults. Within this broad field, the scope of adult education (IDA) refers exclusively to activities aimed at acquiring a qualification in the education system and to literacy and learning courses in the Italian language. Adult education is offered by Adult Education Centres (CPIA) and Secondary Secondary Schools.

Adult education is promoted by CPIAs (Provincial Centers for Adult Education) established by Presidential Decree 263 of October 29, 2012. They are a type of autonomous educational institution with its own staffing and specific educational and organizational structure. CPIAs carry out the following activities: Pathways of Adult Education, Initiatives to expand educational offerings, Research, experimentation and development activities in adult education.

The National System of Evaluation (SNV) is a strategic resource to guide school and training policies for the cultural, economic and social growth of the country and to foster the full implementation of the autonomy of educational institutions.

The evaluation of the efficiency and effectiveness of the educational system of education and training serves to improve the quality of training provision and learning.

The National Assessment System consists of:

- **INVALSI: National Institute for the Evaluation of the Education and Training System**.

INVALSI, a research body endowed with legal personality, on the basis of the current Laws, which are the result of a normative evolution increasingly focused on the evaluative and qualitative aspects of the school system:

makes periodic and systematic verifications of students' knowledge and skills and of the overall quality of the training offered by educational and vocational education and training institutions, including in the context of lifelong learning; in particular, it manages the National Evaluation System (SNV);

studies the causes of school failure and school dropout with reference to the social context and types of educational offerings;

provides for the assessment of students' learning levels at the conclusion of upper secondary education courses, using the written tests of state examinations according to criteria and methods consistent with those applied internationally;

provides support and technical assistance to school administration, regions, territorial authorities, and individual educational and training institutions for the implementation of autonomous monitoring, evaluation and self-evaluation initiatives;

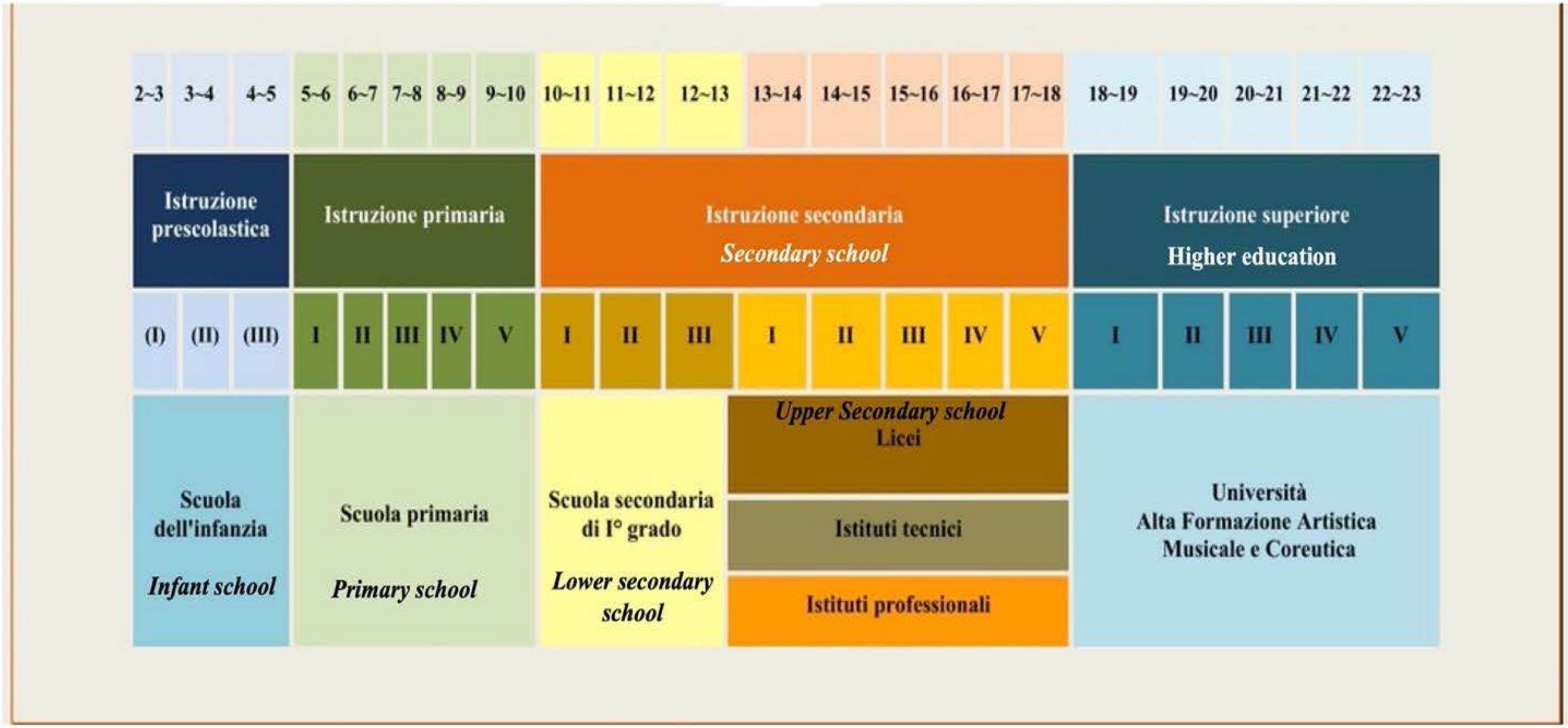
carries out training activities of school teaching and management personnel, related to the processes of evaluation and self-evaluation of educational institutions;

carries out research activities, both on its own initiative and on behalf of public and private entities; ensures Italian participation in European and international research projects in the field of evaluation, representing the country in the relevant bodies;
formulates proposals for the full implementation of the evaluation system for school leaders, defines the procedures to be followed in their evaluation,

- Indire: National Institute for Documentation, Innovation and Educational Research
It has been the point of reference for educational research in Italy for nearly 100 years.
Since its inception in 1925, the Institute has accompanied the evolution of the Italian school system by investing in training and innovation and supporting school improvement processes.
The Institute develops new teaching models, experiments with the use of new technologies in training paths, and promotes the redefinition of the relationship between spaces and times of learning and teaching. Indire has a consolidated experience in in-service training of teaching, administrative, technical and auxiliary personnel and school leaders and has been the protagonist of some of the most important elearning experiences at the European level.
Together with Invalsi and the inspection body of the Ministry of Education, Indire is part of the National Evaluation System in education and training. Within this framework, the Institute develops actions to support processes of educational improvement for the raising of learning levels and the good functioning of the school environment.
Through quantitative and qualitative monitoring, databases and research reports, Indire observes and documents phenomena related to the transformation of the curriculum in technical and vocational education and to school and work issues.
The institute is responsible for managing Erasmus+, the European Union's education, training, youth and sports program for the period 2021-2027.

- Inspection Contingent
It is composed of central and peripheral managers vested with the technical inspection function and is responsible for evaluating schools and school leaders, pursuant to Legislative Decree 150/2009

Italian system of education



2.6. LITHUANIA

Education is a priority area of development in Lithuania supported by the state. It is based on humanistic values of the nation and world culture, democratic principles and universally recognized human rights and freedoms.

The education system is based on the principles of equal opportunities, contextuality - it is closely linked to the context of the economic, social, and cultural development of the country, efficiency - the education system strives for good quality results, and continuity.

EDUCATION GOVERNANCE

Lithuania's education system is more decentralized, than centralized. National institutions, municipalities and educational institutions all share responsibility for the quality of the education provided. The Seimas (Parliament) forms education policy at the national level. It adopts laws and declarations on policy changes. The Government *in corpore* and the Ministry of Education, Science and Sport (and other related ministries) also formulate and implement education policy and adopt and implement legal acts other than laws and declarations.
The Seimas adopts the main laws and legal acts regulating the system of education and science. These are applicable at the national level. The Ministry of Education, Science and Sport or the Government adopts other legal acts applicable at the national level such as the Description of the Primary, Lower Secondary and Upper Secondary Curriculum. The municipalities set and implement their own strategic education plans that are in accordance with the national documents. The municipalities are responsible for ensuring formal education up until the age of 16, organizing non-formal education, transportation to educational institutions and other aspects. The school organizes the education process – for example, teachers are able to adapt the core curriculum to children's individual needs. Formal education is typically provided by public entities. However, private sector education providers are recognized and regulated by national legal acts.

FUNDING PRINCIPLES

Education is a priority for the state and is publicly funded at all levels. Education is free at all stages, with one exception – higher education. There, around half of students have to finance their own studies according to their achievements.
On 1 September 2018, the funding model for pre-school, pre-primary and general education was changed. It shifted from a 'money follows the learner' principle (usually called the 'pupil's basket') to a basic education costs basket, which is coherent with the implementation of curricula (usually called the 'class basket'). This means that approximately 80% of funding is allocated not to each pupil ('pupil's basket') but according to the size of a class. A small percentage is allocated to textbooks and other educational supplies according to the actual number of pupils. Municipalities allocate the remaining less-than-20% of the funds to the organization and management of the education process, education aid, the assessment of learning achievements, etc. The funding of vocational education and training and higher education is based on the 'pupil's basket' or 'student's basket'. This method was in place for pre-school, pre-primary and general education until 1 September 2018. It is a purposive state subsidy that is distributed via the municipalities to the schools, or directly to the higher education institutions according to the actual number of pupils/students.
The 'pupil's basket' and the 'class basket', which consists of funds for education, is provided to both state and private educational institutions. The 'student's basket' is provided to state higher

education institutions. In state schools, the remaining funds required are provided by the founder (usually the municipality or, in case of higher education institutions, the state). Private schools can raise the money by charging tuition fees, obtaining it through private sponsorship, etc.
External educational institution inspections are organized by governmental institutions with the purpose of assuring quality.

TODAY'S BASIC PRINCIPLES OF LITHUANIAN EDUCATION AND NATIONAL POLICY

CONSTITUTION

The most important principles of public education are laid down in the country's fundamental law, the Constitution. The Constitution was adopted by the citizens of Lithuania by referendum on 25 October 1992. The Constitution provides that:

- education is compulsory for persons under 16 years of age.

- Education in state and municipal general education and vocational schools is free.

- Higher education is available to all according to each person's abilities.

- Citizens in good academic standing are guaranteed free tuition at public higher education institutions.

These basic principles are reflected in the legislation governing education, science, and studies.

EDUCATION LAW

The Education Law is the main document governing the education system. The Law on Education sets out the objectives of education in Lithuania, the principles of the education system, the structure of the education system, the foundations of educational activities, educational relations, and the obligations of the State in the field of education. Vocational training and higher education and studies are additionally regulated by the laws dedicated to these areas.

The Law on Education sets out the principles of the education system:

- Equal opportunities, including social justice, the realization of rights, equal access to education and the possibility of improving existing qualifications or acquiring new ones.

- Contextuality, where the education system is closely linked to the economic, social, and cultural development of the country.

- Effectiveness, focusing on efficiency and quality.

- Continuity - the education system is flexible, open, based on the interaction of different forms and institutions; it enables everyone to learn throughout life.

THE EDUCATION ACT SETS OUT THE FOLLOWING EDUCATIONAL OBJECTIVES:

- to develop in each person the value orientations, to enable him/her to act independently and to help him/her to develop the skills needed for the modern world.

- To identify a person's creative abilities, to help him/her acquire competences and/or qualifications and to enable him/her to develop through lifelong learning.

- To strengthen the capacities of society to ensure the full development of a democratic state, competitiveness and national security.

- To transmit to the individual the traditions and values of national, European and world humanistic culture.

- To enable the individual to acquire the foundations of a civic and political culture embodying democratic traditions.

THE NATIONAL EDUCATION STRATEGY 2013-2022

The Law on Education stipulates that the main document regulating the direction of educational change in Lithuania is the National Education Strategy 2013-2022. This document sets out the priorities of Lithuanian education policy, the long-term objectives of education, and the directions for change in the content and financing of education.

The National Education Strategy formulates four main objectives of national education policy:

- Reflective, continuously developing and efficient professional teachers and lecturers.
- A culture of educational quality is in place.
- Creating the conditions to unleash individual abilities and meet special needs.
- Establishing a system of incentives and a level playing field for lifelong learning.
-

The Good Schools Concept was approved by the Minister of Education and Science on 21 December 2015. This document sets out the guidelines for raising the level of quality of school performance, the direction a school should take and the guidelines for how a school can achieve all this. At the same time, legislation and documents in the field of education need to change in order for this to be implemented. The concept of a good school states that a good school is one that bases its education on humanistic values, strives for discovery and personal success, and is guided by the agreements and learning of the school community.

A GOOD SCHOOL IS ONE THAT:

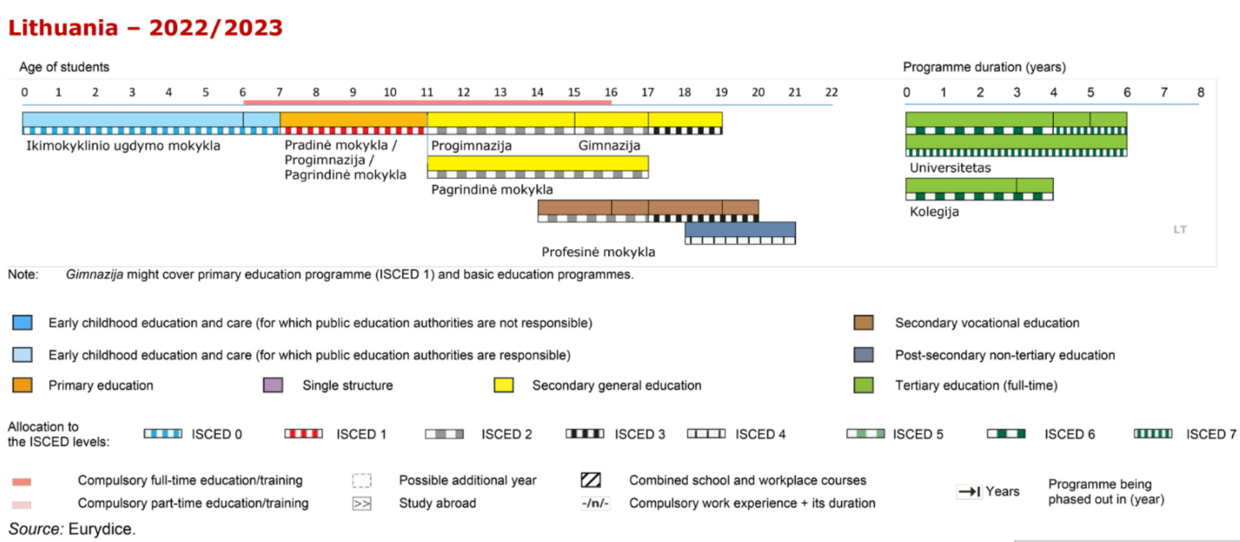
1. It fulfils its mission well by creating rich, enjoyable school experiences and, through the process of achievement, strives for personal maturity.
2. It values all the factors that contribute to the achievement of the mission: the educational environment, the school staff, the school community, leadership, and management.
3. The local community and local government encourage and help a good school to grow.

THE EDUCATION SYSTEM AND ITS STRUCTURE

According to the Constitution of the Republic of Lithuania, education in Lithuania is compulsory until the age of 16
The following are the main reasons for this. Children start primary school at the age of 6-7 years.
There are private and public schools and higher education institutions in Lithuania. Share
Some of the services of public educational institutions are free for foreigners.
The school year in Lithuania starts on 1 September and runs until June/July (duration depends on the type of educational institution). The school year is divided into two semesters - autumn and spring.

ORGANISATION AND STRUCTURES

A child must start attending pre-primary education on turning 6 years of age during the calendar year (pre-primary education is obligatory). Education is compulsory until the age of 16, meaning that primary and lower secondary education is mandatory. Students' progress and achievements are measured through standardized testing in the 2nd, 4th, 6th and 8th grades. The standardized testing is not compulsory. It can be initiated by schools or municipalities. The development of test items, assessment instructions and recommendations on how to interpret the results of the standardized tests are centralized. Schools are responsible for test administration and assessment procedures. The assessment of lower secondary education achievements in grade 10 (grade II in gymnasium schools) is mandatory. Upper secondary education is concluded by mandatory Matura examinations, which are used both to evaluate pupils' achievements and to enter higher education institutions. Learners are granted some freedom in choosing study subjects in the two final years of their lower secondary education. This is expanded on greatly in upper secondary education and tertiary education.



STAGES OF THE EDUCATION SYSTEM

The system of education in Lithuania includes the following stages:

Pre-school and pre-primary education. In Lithuania, early childhood education and care is composed of pre-school (ikimokyklinis ugdymas) and pre-primary (priešmokyklinis ugdymas) education and is attributed to the type of non-formal education. Pre-school education is not compulsory. At the request of the parents, the child can be educated according to the pre-school curriculum. Pre-school education is provided for children from birth to pre-primary education. In order for the child to prepare for the successful completion of the primary education curriculum, pre-primary education groups are set up. Attendance is compulsory for pre-primary education when a child turns 6 years of age in the calendar year. Pre-school and pre-primary education can be offered at pre-primary classes in ECEC settings at general education schools. It can be provided by licensed freelance teachers or other education providers in accordance with the legal acts. Pre-school and pre-primary educational institutions fall under the authority of local governments.

Primary and lower secondary education. Children must start attending primary schools when they turn 7 years of age during the calendar year. Education is compulsory until the age of 16. Primary and lower secondary education is free of charge in public educational institutions. Primary education lasts for 4 years. Its purpose is to provide children with the fundamentals of learning, literature and social and cultural skills. It is delivered by primary schools (pradinė mokykla, an institution that provides education for grades 1 to 4), pre-gymnasiums (progimnazija, a general education institution that provides education for grades 1 to 8) or school-multifunctional centers (daugiafunkcis centras, an institution that provides early childhood education and care, education from grades 1 to 12, and other formal and non-formal education, cultural and social services). Lower secondary education lasts for 6 years and is also compulsory. Children usually enter lower secondary education when they are 10 to 11 years of age. It is delivered by pre-gymnasiums, lower secondary education schools (pagrindinė mokykla, a lower secondary education school and general education institution providing education for grades 5 to 10), gymnasiums (gimnazija, a general education institution that provides education for grades 9 to 12), school-multifunctional centers and vocational education and training (VET) schools. Education is compulsory until 16 years of age. By that time the learner will have usually finished the course of lower secondary education (10 grades).

Upper secondary and post-secondary non-tertiary level. The two-year upper secondary curriculum is implemented by gymnasiums. VET schools along with a vocational education and training curriculum may provide the basis for the last two years of the lower secondary curriculum and/or upper secondary curriculum. Post-secondary non-tertiary curriculum is provided in VET schools and other institutions. Students typically aged from 17 to 19 learn there. A vocational education and training curriculum lasts from 1 to 2 years. Vocational education and training can be organized in school or apprenticeship formats.

Higher education. Higher education comprises two types of institutions: universities (universitetas) and colleges (kolegija). Learners can begin their higher education after gaining an upper secondary education. The degree structure follows a three-cycle structure: Bachelor's, Master's and Doctoral-level studies. The first cycle of studies (Bachelor's) usually lasts for four academic years, the second cycle (Master's) two years and the third cycle (Doctoral) four years. Starting in 2018, short-cycle studies were introduced into the higher education system. Short-cycle studies are intended for the acquisition of the Lithuanian qualification framework's Level V qualification (ISCED 5). VET schools together with colleges can provide joint short-cycle studies after coordination with the Ministry of Education, Science and Sport. Legal acts implementing short-cycle studies are being prepared.

VOCATIONAL TRAINING

Vocational training is not compulsory, but the state guarantees access to initial vocational training. Vocational training can be initial, where the first qualification is obtained. Continuing vocational training involves upgrading an existing qualification or acquiring a new one.

Apprenticeship training is not available until the age of 14. A pupil who has not completed his/her basic education is enrolled in a vocational training program at the same time as a pupil who has not completed his/her basic education program. A pupil who has already completed his/her basic education may study a vocation only or a vocation and secondary education. Vocational training and basic education last 3 years. Vocational training with secondary education is also 3 years. Vocational training without primary or secondary education lasts between 1 and 2 years.

Upon completion of the formal vocational training program and/or an assessment of his/her competences, the apprentice obtains a qualification at the appropriate level. A pupil who completes a program of basic education in parallel with a vocational training program shall acquire basic education. After completing the secondary education program and passing the matriculation examinations, the apprentice obtains secondary education.

Continuing vocational training includes formal and non-formal vocational training. A person who has completed a formal vocational training program and/or who has received an assessment of his/her acquired competences in accordance with the established procedures shall be awarded a qualification at the appropriate level.

Vocational training shall be provided by a vocational training institution, a freelance teacher, or another person providing vocational training for which vocational training is not the main activity. Vocational training establishments, in cooperation with employers' representatives, shall draw up training programs in accordance with the relevant vocational training standard and the general requirements laid down.

State-funded study places are available in initial vocational training. The number and type of places are determined by the State, considering information from the national human resources monitoring, vocational training institutions and qualifications, suggestions from sectoral vocational committees on the feasibility of apprenticeships, etc. The farm funds are allocated by the institution with the status of owner of the institution. Continuing vocational training of employees of an enterprise, institution, organization or farm shall be carried out at the expense of the enterprise, institution, organization or farm or at the expense of the trainees.

HIGHER EDUCATION STUDIES

Higher education studies are part of formal education. Higher education is not compulsory, but the state guarantees access to higher education.

Higher education is available to a person who has completed secondary education, i.e., 12 years of schooling, and who is able to study independently.

Higher education study programs are run by higher education institutions - universities and colleges. Study programs are university and college based.

Higher education institutions offer degree programs and non-degree programs.

Degree programs can be at three levels. The first stage is a professional bachelor's and bachelor's degree, the second is a master's degree and the third is a doctoral degree. Professional bachelor's degree programs are run by colleges and bachelor's degree programs by universities. The second cycle degree programmers are run by universities. Doctoral studies are carried out by universities or by universities together with research institutes.

Non-degree programs are designed for the acquisition of qualifications or for the preparation for independent practical activities. These include residency, pedagogical studies, and other fields of study as defined by the Government.

Studies are full-time and part-time. For full-time studies, the normal duration of one year is 60 credits. It may vary but shall not be less than 45 credits. Extended studies must be a maximum of 45 credits per year. The total duration of part-time studies may not be more than 1,5 times longer than full-time studies (at the rate of 60 credits).

The duration of the vocational bachelor's and bachelor's degree shall be at least 180/210 and not more than 240 credits. The Master's degree shall be 90-120 credits. The duration of doctoral studies shall be up to 4 years in the full-time form and up to 6 years in the part-time form. Higher education study programs lead to higher education degrees and/or qualifications.

Persons enrolled at a public higher education institution may apply for a state-funded study place. In this case, the student does not have to pay tuition fees. People who have completed general education with the best results and wish to study at a non-state higher education institution may be eligible for a state scholarship. The amount of this grant per year corresponds to the normative cost of one year's tuition. If the annual tuition fee set by the higher education institution is higher than the normative tuition fee, the student must pay the remainder of the tuition fee.

NON-FORMAL EDUCATION (EXCLUDING EARLY CHILDHOOD EDUCATION)

NON-FORMAL EDUCATION FOR CHILDREN

Non-formal education for children (NFE) is divided into non-formal education and education complementary to formal education (ECFE). VET differs from non-formal education for children in that it is delivered through long-term programs and systematically expands knowledge in a particular field, strengthens skills and abilities, and provides individuals with additional subject competences. An example of an FFS program is a ten-year music program in a music school complementing formal education.

A child can be educated from birth in a non-formal children's education program. In the FFS program, children start to learn from around the age of 4.

Non-formal children's education programs are run by music, art, art, sports, other schools, free teachers, and other education providers. Competences acquired through non-formal learning can be recognized as part of a formal education program or qualification. A program of long-term artistic education for children in music, art, sport, or other schools may be recognized as a vocational training module.

The amount of the fee for non-formal education in a public non-formal education establishment for children shall be determined by the authority having the status of owner. In the case of a non-state provider of NFE, the amount of the fee shall be determined by the owner of the provider or by the provider itself. For school-age children, the State provides an 'NFE basket' of between €10 and €20 per pupil (€15 per pupil is recommended).

Non-formal adult education

Non-formal adult education aims to enable people to pursue lifelong learning, to meet their cognitive needs, to improve their qualifications and to acquire additional competences.

Non-formal adult education is offered to everyone who chooses it. The person must be at least 18 years old. Non-formal adult education can be provided by all education providers.

Competences acquired through non-formal education may be recognized as part of a completed formal education or study program.

Education in Lithuania is defined as an activity aimed at providing a person with the foundations for a full independent life and helping him/her to continuously improve his/her abilities. Learning is a natural right of every human being. Education, as a way of building the future of the individual, society, and the State, is based on the recognition of the inestimable value of the human person, his freedom of choice, his moral responsibility, democratic relations, and the country's cultural traditions. Education protects and builds the identity of a nation, transmits the values that make human life meaningful, society cohesive and solidarity, and the state progressive and secure. Education serves its purpose best when its development is ahead of the general development of society. It is a priority area of societal development which is supported by the State.

Rights and obligations of pupils and parents/guardians

The most important right that every Lithuanian citizen and foreigner residing permanently or temporarily in Lithuania has been the right to education, training and qualification. Every Lithuanian citizen and foreigner permanently or temporarily residing in Lithuania is guaranteed by the state:

1) pre-school, primary, primary, and secondary education.

2) access to higher education studies or vocational training leading to a first qualification.

The rights and obligations of pupils are set out in detail in Article 46 of the Law on Education. Some of them are listed below:

The student has the right to:	The student must:
- going to school, self-education and education and qualifications - access to good quality education. - to learn in an environment of mutual respect and psychological, spiritual, and physical safety.	- enroll in pre-primary, primary, and basic education up to the age of 16. - attend school, study diligently and observe the standards of student behavior. - abide by all the requirements of the learning agreement and the school's policy documents.

- to an impartial assessment of their learning achievements. - to participate in school self-government. - to the consistent and sustained development of social and emotional competences at school.	- participate in consistent and sustained prevention programs.

Parents (guardians, carers) have the right to:	Parents (guardians, carers) must:
- Participate in the selection (if necessary) of the child's education program, form, school, or other education provider. - receive information about the child's condition, educational and developmental needs, progress, school attendance and behavior. - Participate in the self-governance of the school. - admit a child aged 5 to pre-primary education and a child aged 6 to primary education. - Demand that the child receives a good quality education.	- Ensuring your child's school readiness and enrolment in pre-primary, primary and basic education up to the age of 16. - to provide the child with healthy and safe living conditions, respecting the child's personality. - cooperate with education professionals in the child's development and follow their recommendations. - ensure that the child attends school punctually and regularly.

KEY CHALLENGES

The effect of exclusion. After analyzing the differences in the achievements of fifteen-year-olds, the results of pupils from families in lower socio-economic groups studying in the same schools were behind the national average by 46 points, or 1.5 school years. Compared to children from families in higher socio-economic groups, their achievements are even worse – they are behind by 86 points, or 2.8 years.

Level of achievements. PISA 2018 results revealed that the achievements of 15-year-olds in Lithuania are still below the average among OECD countries' results. Comparing them with the PISA 2015 results, it is clear that the level of achievements has increased only by a little.

Network of educational institutions. One more challenge is the large network of educational institutions – it does not reflect the demographic decline of recent years. For example, there were more than 563,000 students in the 2004-2005 academic year and approximately 322,000 students in 2018-2019. The network of general education institutions is shrinking. The network of state universities is being optimized.

A teacher – a (low) prestige profession. Another challenge is a teaching community that is aging and not easily renewed with younger teachers. Some 40% of teachers are between the ages of 50 and 59, around 30% are between 40 and 49 and only 3% to 5% of teachers are younger than 30. The main reasons why the teaching profession is not attractive are the salaries (among the lowest in the EU), a limited possibility to upgrade professional qualifications and the unattractive image of the teacher's profession in society. On 1 September 2018, a full-time payment system was introduced. After some flaws were noticed it was updated and will be updated again if there is such a need.

Leadership in educational institutions. Reform among educational institutions' heads (principals) has shown that it is difficult to attract new and motivated school heads to educational institutions. Low salaries, great responsibilities, administrative burdens, difficult competition when applying for the position and fixed-term contracts do not motivate people to apply for a managerial position. A working group set up by the Ministry on Education, Science and Sport is preparing a set of measures to encourage school heads to apply and to renew the corps of school principals.

Key features related to the teaching profession

On 14 September 2017, a new Teacher Training Model (Model) (Pedagogų rengimo modelis) was approved. This model seeks to modernize the initial stage of teacher training. Firstly, it is aimed at attracting truly motivated future teachers to pedagogical studies. It has started to use a complex admission system, assessing the candidates' learning achievements, values, motivations, and personal characteristics. During the studies, students' suitability for the profession must also be re-evaluated.

The initial stage of teacher training is still organized using consecutive and concurrent models. Teaching qualifications can also be obtained after completing professional studies and in alternative ways, for example through programs such as 'I Choose to Teach!' (Renkuosi mokyti!). According to the legal acts, teachers are provided with conditions for continuing their professional development. Until the adoption of the new Model, it was and is indicated in the Law on Education that teachers must upgrade their professional qualifications. Teachers are entitled to at least five days a year for attending in-service training (professional development) events. The new Model is intended to encourage teachers to obtain additional qualifications in a subject or a pedagogical specialization. An employed teacher can also pursue a higher level of competence. Participation in continuing professional development leads to salary increases and career benefits. In the Model, a new pedagogical training phase – a one-year pedagogical internship – has been established for the first time. It will be compulsory for beginner teachers.

LITHUANIAN EDUCATION VISION

The vision for education in Lithuania is that every child, young person and adult in Lithuania seeks and easily finds a place to learn, and that the country's education system consists of state, municipal and non-state educational institutions, which are constantly evolving, cooperating with each other and with partners, and where their staff have authority in society and are engaged in a continuous discussion on the country's educational development, on the success of the State of Lithuania, its people and on the development of the culture and the economy in a sustainable manner in the light of sustainable development of the urban and rural areas.

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03

Early School Leaving and Dropout

3.1 EU LEVEL

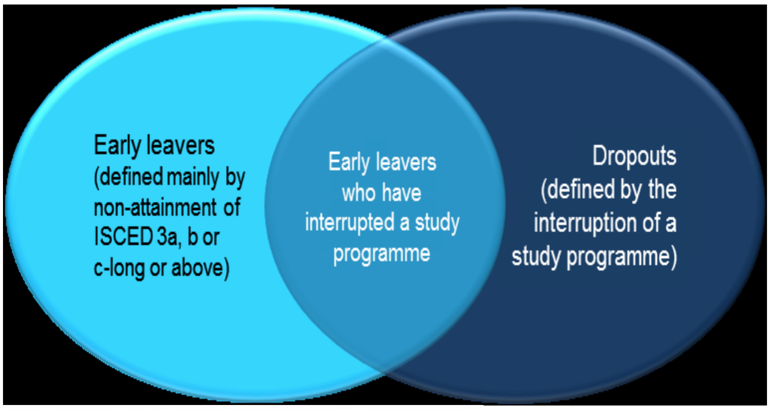
Introduction

Definitions of Early School Leaving / Dropout / NEET

The term Early Leaving from Education and Training (ELET) has been coined at EU level. Early leavers are defined as 18-24 year-olds with only lower secondary education or less who are no longer in education or training. Early leaving can therefore be distinguished from **'drop-out', which refers to discontinuing an on-going course,** e.g. dropping out in the middle of the school term.

ELET

Early leaving from education and training (ELET) refers to all forms of leaving education and training before reaching the end of upper secondary level and an equivalent school leaving certificate. This broad definition encompasses countries' own definitions of who in the national context is considered to be an early leaver. It includes, for example, countries who refer to young people who leave (or drop out of) school without completing what is considered in the national context as basic education (usually primary and secondary education), as well as those who define early leavers as young people who leave school without an upper secondary school leaving certificate.



NEET' stands for young people aged 16-24 Not in Education, Employment or Training (NEET). A person identified as NEET is either unemployed or economically inactive and is either looking for work or is inactive for reasons other than being a student or a career at home.

Data collection and policies

It is important to note that the way early leaving is defined in countries is often linked to the data collection process and this, in turn, can have an effect on the policies being developed to prevent or reduce it. A focus on drop-out may, therefore, result in increased efforts to prevent it and to intervene as early as possible. Focusing on the number of young people who have not completed upper

secondary education, on the other hand, may trigger measures that aim to help them re-enter education or training to complete their studies.
In order to understand why young people leave education and training early, it is moreover important to see early leaving not only as a status or educational outcome but as a process of disengagement that occurs over time. Chronic absenteeism and exclusion from school can be among the symptoms, or may even be the cause of students leaving early. However, there are more signs which indicate that students may be at risk. Warning signs may occur as early as in primary school. They may be related to individual factors (e.g. educational performance, behaviour, attitudes) or to factors within individuals' families, their schools, and communities. Understanding early leaving from education and training as a complex process, detecting early signals and identifying students who are at risk of leaving education and training early is therefore a prerequisite for developing targeted and effective measures to prevent it.

Factors associated with early leaving

In July 2019, the report "Assessment of the Implementation of the 2011 Council Recommendation on Policies to Reduce Early School Leaving" presented analysis of the key contributory factors related to ESL.

Factors explaining ESL

There is not one 'ESL problem' or reason which can explain why a young person leaves school. Research shows that the interplay of a number of complex factors related to the individual situation of each student contributes to the likelihood of early school leaving. These factors include **individual needs** (e.g. disability, psychological issues, academic underachievement, mental health), **socio-economic background** (e.g. migrant background, poverty, workless households, rural/urban location), **school-based factors** (e.g. lack of resources, lack of guidance and support, inappropriate teaching methods), and **national contextual factors** (e.g. economic situation, labour market situation, availability of education and training policies, value placed on education). People at risk ESL are often suffering from multiple disadvantages and are affected by a complex mix of the factors identified above.

Key contributory factors.

Disadvantaged socio-economic background appears to be a strong factor which influences early school leaving. Difficult family situations - such as unemployment, low household income, people facing social exclusion and low levels of parental education - can have a direct and lasting effect on students' school trajectory, their attitudes towards learning, their educational achievement; and this can consequently contribute to their decision to leave education and training early. Other key poverty-related issues affecting ESL include homelessness and street children, and lack of service coordination for migrants.
An additional societal factor identified in the literature is the perception of education. In countries where the national appreciation for education and formal qualifications is higher, the levels of early school leaving tend to be lower. The reverse also holds true; when society demonstrates distrust or displeasure with the education system in a country, there is a higher likelihood of higher ESL rates.
Mental health issues also increases the risk of early school leaving. These issues were for example examined in a literature review, looking in particular at students who externalised problems (and tended to be more disruptive in classrooms) or internalised them (turning the problems in on themselves, and often having poor social skills, but often better able to cope). This research indicates that those with externalised problems are more prone to ESL.
Issues of transition, whether from primary to post-primary, or middle to upper secondary, or from preschool to primary are also related to ESL. Another factor mentioned recurrently by consultees throughout our research relates to the **quality of education, including VET tracks**. This is supported by other research, which highlights a priority to introduce greater flexibility within VET provision

and the need for a stronger emphasis on social and emotional support and life skills within VET curricula in many countries.
The influence of **national contextual factors**, such as the economic situation and employment levels, can also have an important impact on the prevalence of ESL.

Strategies on early school leaving should be based on an analysis at national, regional and local level of the conditions leading to the phenomenon, as average rates often mask large differences between different regions or countries. Early school leavers are a heterogeneous group and individual motivations to leave education prematurely differ widely. Family background and wider socio-economic conditions such as pull from the labour market are important factors. Their impact is conditioned by the structure of the education and training system, by available learning opportunities, and by the learning environment. The coordination of policies addressing the well-being of children and young people, social security, youth employment and future career perspectives has an important role to play in reducing early school leaving.

Other factors included in research as associated with early leaving were:

(a) family background:
(i) migration or ethnic minority origin;
(ii) lower socioeconomic status of parents;
(iii) parental attitudes towards education;

(b) individual characteristics (not education related):
(i) gender;
(ii) health situation;
(iii) low self-esteem;
(iv) conflictual relationships with adults;

(c) individual's education pathway:
(i) disengagement from learning;
(ii) absenteeism;
(iii) class repetition;
(iv) low academic achievement;
(v) negative perception of school/education;

(d) school and classroom climate:
(i) conflict with teachers;
(ii) bullying;

(e) labour market attraction.

EU policy

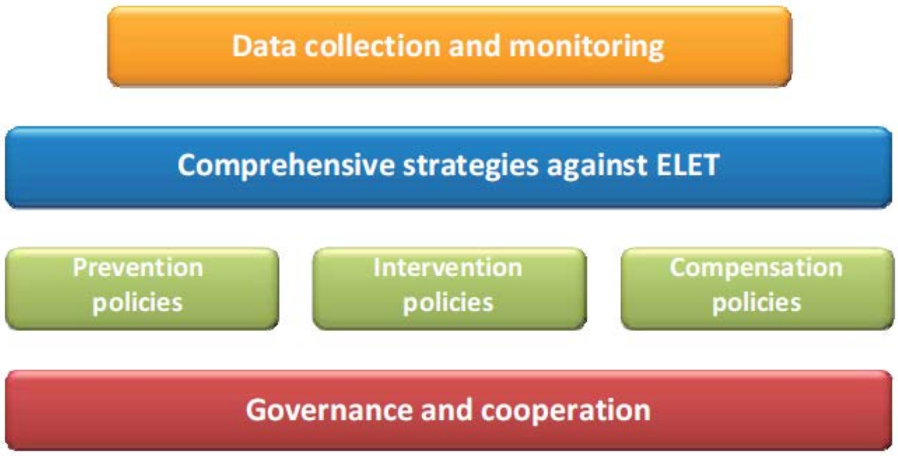
Education is vital for positive economic, personal and social development. More years of education are also associated with higher 'earnings advantage'. In the context of countries with knowledge–based economies, education is the main lever to achieve a flourishing personal life and democratic, fair, inclusive and competitive society. However, a significant proportion of young people in EU countries drop out of the education system, without completing what is considered in the national context as the basic education necessary to achieve their future social and employment potential. Research has shown that ESL and by consequence educational underachievement are among the principal barriers to achieving equitable societies. It has also shown that underachievement is determined by socio-economic, cultural, and linguistic status.

The headline target to reduce the number of early school leavers in Europe to under 10% by 2020 was announced in 2010 as part of the wider set of goals within the Europe 2020 Strategy17. After the adoption of the Strategy, the Commission adopted, on 31 January 2011, a set of policy documents addressing early school leaving. These comprised: a Commission Communication on 'Tackling early school leaving: A key contribution to the Europe 2020 Agenda', a Staff Working Paper on 'Reducing early school leaving' and the proposal for the Council Recommendation on policies to reduce early school leaving, referred to in this report as the 2011 Recommendation.

The 2011 Recommendation aimed to provide the tools and policy impetus to encourage efforts at a national level across the EU in moving towards the 10% headline target. It established for the first time a common reporting mechanism for efforts to tackle ESL via the Annual Growth Survey (AGS), and represents a call for countries to implement comprehensive strategies, to include groups at increased risk of dropping out in their measures, to address ESL both in general education and in VET, and to involve other policy sectors.

It includes recommendations to the Member States on implementing a policy framework to tackle ESL, and invites the Commission to support national policy efforts through a variety of actions at EU level including monitoring, facilitating the exchange of good practice, launching comparative studies and research, and integrating measures aimed at tackling ESL in all relevant Union policies addressing children and young people. The Annex to the Recommendation sets out a framework for comprehensive policies to reduce early school leaving. The framework includes the need to identify the main factors and monitor ESL, as well as a framework comprising policies under three key pillars which should all be addressed in national ESL strategies: prevention, intervention and compensation. The Recommendation was adopted on 28 June 2011.

Government action



Data collection

Each country follows a detailed registration system of early school leavers

Comprehensive strategies

Prevention policies, which aim to tackle the root problems that may eventually result in early leaving.

Intervention policies, which aim to combat any emerging difficulties experienced by students, by improving the quality of education and training and providing targeted support.

Compensation policies, which create new opportunities for those who have left education and training prematurely to gain qualifications.

Governance

Education and career guidance, which encompasses all three areas, prevention, intervention and compensation, is being crucial for addressing early leaving.
Strong **governance arrangements** are needed to manage the relationships across the relevant policy areas and agencies ('horizontal cooperation') as well as between the various levels of government – national, regional, local and school level ('vertical cooperation'). The ability to work with private and non-governmental bodies such as employers and trade unions (cross-sector cooperation) is also essential.
Vocational education. VET can have a remedial role in tackling ELET, acting as a safety net for those who drop out from general education and who may otherwise have become early leavers.

School environment as contributory factor to ESL. Recommendations

Policy measures in the 2011 Recommendation
The Annex to the 2011 Recommendation sets out a broad range of policies across three key pillars: prevention, intervention and compensation. The list of policies is not intended to be exhaustive or prescriptive, but rather indicative of the type of policies contributing to the three pillars. Countries are encouraged to select policies based on national circumstances and contexts, underpinned by systematic data collection, monitoring and evaluation.

As defined in the 2011 Recommendation, **prevention policies** aim to 'reduce the risk of early school leaving before problems start. Such measures optimise the provision of education and training in order to support better learning outcomes and to remove obstacles to educational success'. The Annex to the Recommendation sets out examples of different types of prevention policies, summarised below.

1. Providing high quality early childhood education and care, especially to those from a disadvantaged background, including migrant and Roma children
2. Increasing the educational offer by providing education and training opportunities beyond the age of compulsory education
3. Increasing the flexibility and permeability of educational pathways
4. Promoting active anti-segregation policies, including to diversify the social composition of schools in disadvantaged areas
5. Policies to support multilingual teaching and learning and to promote linguistic diversity in schools, including inter-cultural learning programmes
6. Active measures to enhance parental involvement in school life through partnerships and forums, and parental engagement in children's learning
7. Measures to ensure access to high quality VET provision, including the integration of VET pathways into mainstream education, and upper secondary and tertiary education
8. Measures to strengthen links between education and training systems and the employment sector, via access to high quality work experience and employer engagement in schools

Intervention policies, as defined in the Recommendation, aim to 'avoid early school leaving by improving the quality of education and training at the level of the educational institutions, by reacting to early warning signs and by providing targeted support to pupils or groups of pupils at risk of early school leaving. They address all educational levels, starting from early childhood education and care to upper secondary education'. In the annex to the Recommendation, a range of intervention policies are set out, addressing both school/training institution and individual levels. The types of intervention policies identified in the Recommendation are summarised below.

Intervention policies at the level of the school or training institution:

1. Developing schools into learning communities
2. Developing early-warning systems for pupils at risk
3. Networking between schools and external actors
4. Supporting and empowering teachers in their work with pupils at risk
5. Providing extra-curricular activities

Intervention policies at the individual level:
1. Mentoring support and target assistance to overcome specific academic, social or personal difficulties
2. Tailoring teaching to pupils' needs, strengthening individualised learning approaches
3. Strengthening guidance and counselling to support students' career choices and transitions within education or from education to employment
4. Access to appropriate financial support for young people with difficult economic circumstances

In the terms of the Recommendation, **compensation policies** aim to 'help those who left school prematurely to re-engage in education, offering routes to re-enter education and training and gain the qualifications they missed'.

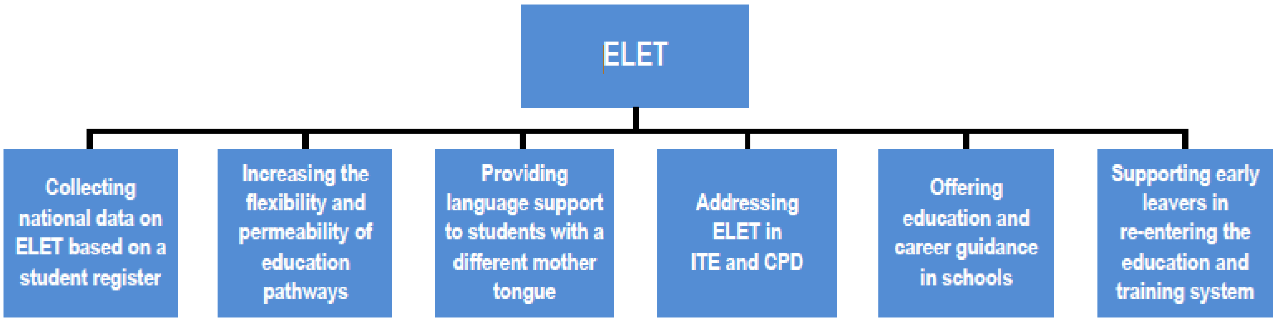
Compensation policies set out in the Recommendation

Compensation policies set out in the Recommendation are summarised below.

1. Successful second chance education programmes, which provide learning environments that respond to the specific needs of early school leavers, recognise their prior learning and support their well-being
2. Diverse learning pathways to return early school leavers to mainstream education
3. The provision of various routes back into mainstream education and training
4. Systems to support the recognition and validation of prior learning, including competences achieved in non-formal and informal learning Providing targeted individual support, which integrates social, financial, educational and psychological support for young people in difficulties.

The measures implemented under these pillars together make up the core of comprehensive strategies on early school leaving, to be implemented at the country level in line with national priorities and the Europe 2020 objectives. As stated in the Recommendation: 'Comprehensive strategies on early school leaving comprise a mix of policies, coordination across different policy sectors and the integration of measures supporting the reduction of early school leaving into all relevant policies aimed at children and young people. In addition to education policies that promote high-quality school systems, these are principally social policy and support services, employment, youth, family, and integration policies. Horizontal coordination between different actors and vertical coordination through different levels of government are equally important.

Factors against early leaving from education and training



A national data collection system based on a student register can be used to understand the scale of the problem and to develop and implement appropriate policies to address ELET. Such a system can also be employed to both monitor absenteeism and evaluate the effectiveness of policies to reduce early leaving. Student register based data can also be employed to monitor absenteeism, thereby acting as a warning system to alert schools and authorities that they may need to intervene to help students at risk of leaving early.

Policies for **increasing the flexibility and permeability of education pathways** can help prevent ELET by removing potential obstacles to the completion of education and training programmes. This indicator focuses on policy initiatives aimed at minimising the risk of early leaving by offering students a wider choice of programmes or alternative pathways (academic, technical or vocational), as well as providing opportunities for students to change tracks or programmes which do not meet their needs. The indicator also covers policies that are designed to ensure a smooth transition between education levels and programmes (especially from general education to VET programmes). It also includes policies that aim to improve the recognition of skills and qualifications, thereby helping students to progress to the next level or to re-engage in education or training if they have left the system prematurely.

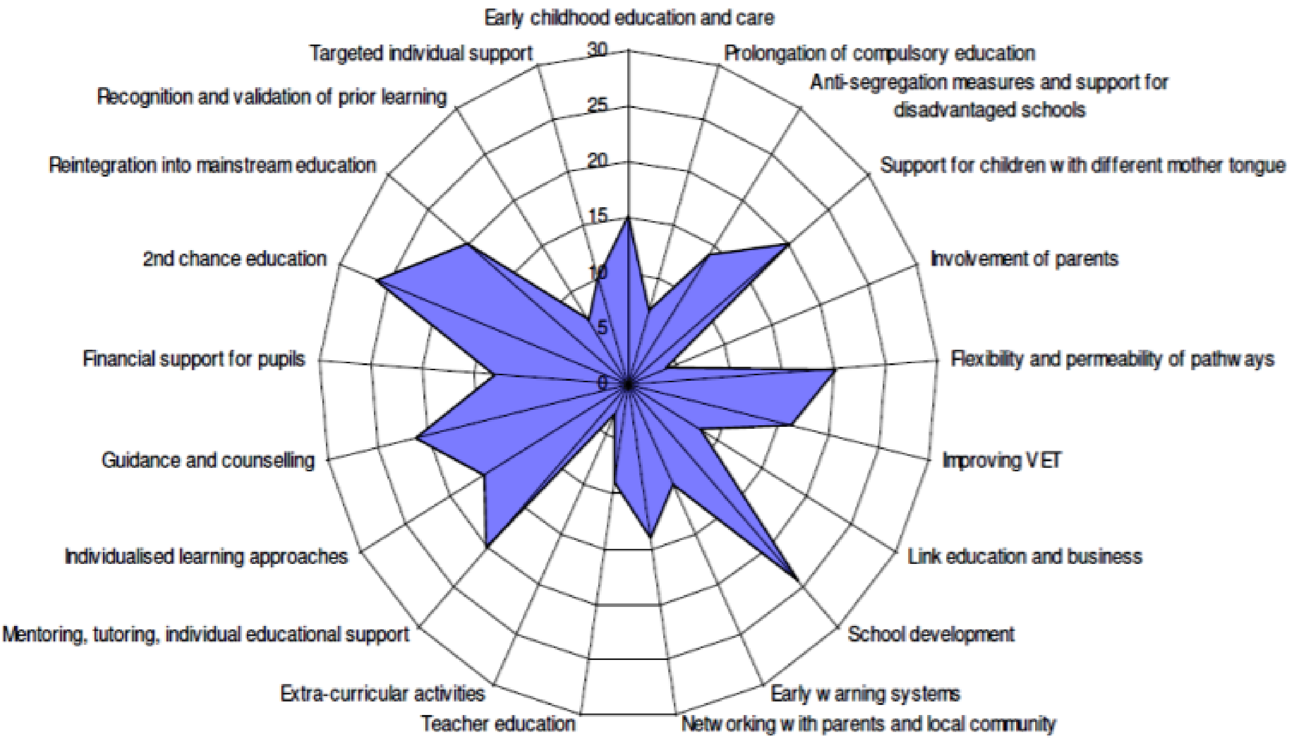
Language support for students with a mother tongue other than the language of instruction can be crucial as these students are often at increased risk of early leaving. Empirically, young people from migrant backgrounds tend to be over-represented among those leaving education and training early in many European countries. Policies on language support for these students can help ensure the provision of measures for strengthening the students' competences in the language of instruction, which are crucial in order to benefit from all the learning opportunities and to avoid falling behind.

Addressing ELET in ITE and/or in CPD is essential if teachers are to learn how to support students who are showing signs of disengagement at school, and who are therefore at risk of leaving school early. This indicator examines policies and measures for improving teachers' understanding of the challenge of early leaving through initial teacher education (ITE) and continuing professional development (CPD). This implies increasing teachers' awareness of the underlying causes, the main triggers and early warning signs, as well as strengthening teachers' capacity to take action in both preventing early leaving and supporting students who are at risk. Training on ELET may also provide teachers with an opportunity to engage in peer learning and collaborate with other teachers and schools with experience in this area.

The role of **education and career guidance services** in preventing students from leaving education and training is widely acknowledged. This indicator analyses policies on education and career guidance, which is provided both as a compulsory part of the curriculum and by school guidance services in lower and upper secondary education. Education and career guidance provides students with information as well as support for developing their decision-making and other skills important for managing their educational and/or career choices. Guidance may also include psycho-social work or counselling to help students, in particular those at risk of leaving early, as they progress through education and training.

Support for early leavers to re-enter the education and training system. This indicator presents policies and measures that help young people who have left education and training early to re-enter the system. This may entail: policies promoting the provision of second chance education, i.e. alternative education and training pathways leading to a formal qualification; education and career guidance, which may be combined with practical skills training, one-to-one or group counselling, or similar support offered to help young people develop a vision for their careers and lives; and initiatives taking place within the context of the 'Youth Guarantee', which seeks to ensure that all young people under 25 get a good quality, definite offer within four months of leaving formal education or becoming unemployed, for a job, apprenticeship, traineeship or continuing education that is adapted to each individual's need and situation.

Factors that can reduce early school leaving



Source: Conze, s. (2012). «The European Commission and policy on early school leaving (ESL)». EIPPEE Conference 2012: Advancing the use of research in education across Europe.

Quality education and School success

Education policies that encourage a stimulating learning environment for all learners, and especially for those who are struggling in school as a result of their individual circumstances and/or family background, can contribute to preventing early leaving. Education and training systems can create this type of learning environment if students are placed at the centre of the learning process and if teaching, learning and support is personalised in order to respond to students' individual needs and talents.
Education system contributes to drop out when operating as a selective mechanism rather than an inclusive one. Important aspects for school success
(a) the positive importance of the feeling of belonging to a group in a classroom or a company;
(b) the influential role of families in young people's education and training;
(c) the teacher-student relationship;
(d) behaviours and relationships in education institutions that affect young people's self-perception and aspirations.
Some aspects of education systems such as grade retention, socio-economic segregation or early tracking are identified as having a negative influence on the rates of early leaving. Grade retention may increase educational inequalities, and the socio-economic segregation of schools may only aggravate the situation of low achievers in geographical areas characterised by low levels of socio-economic status and student achievement. Directing students into different educational pathways or tracks too early by placing them into either academic or vocational programmes based on their

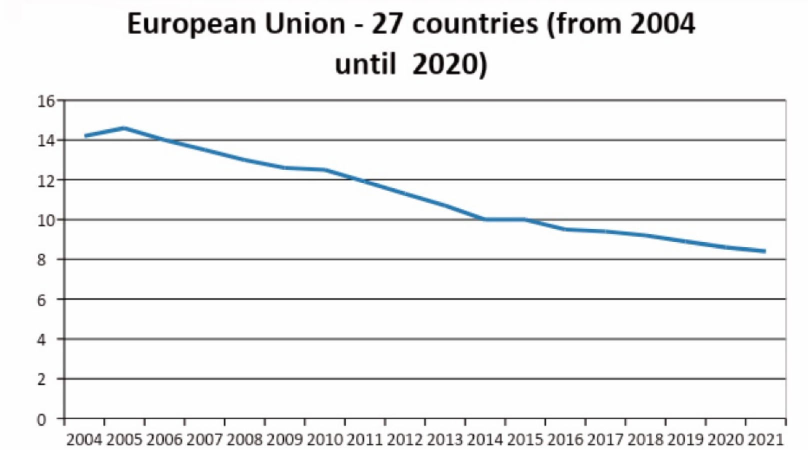
achievements, can also be detrimental to their education outcomes as they may become demotivated and lose interest in learning.

Students who feel strongly connected with their school and value education highly are generally more likely to accept school values as their own and become more involved in various school-based activities, which increase their chances of educational success. Additionally, highly valuing education is associated with higher academic attainment. Also, a positive perception of oneself as a learner increases the probability of educational success.
Students who feel they are understood, receive care and help in various life situations are usually more involved in their education and declare a higher sense of belonging to the school. Therefore, the support students receive from teachers in school seems to be an important factor in protecting youngsters from leaving school early.
Schools that invest in strengthening the development of a positive and supportive school climate, as well as tackling peer victimisation are more successful in fostering school engagement. Moreover, students who experience violence from their peers are at real risk of school disengagement.

STATISTICS Early school leavers' in the EU and in regions

Statistics on early school leaving are available since 2004 from Eurostat. The average for euro area is shown in graph 1.

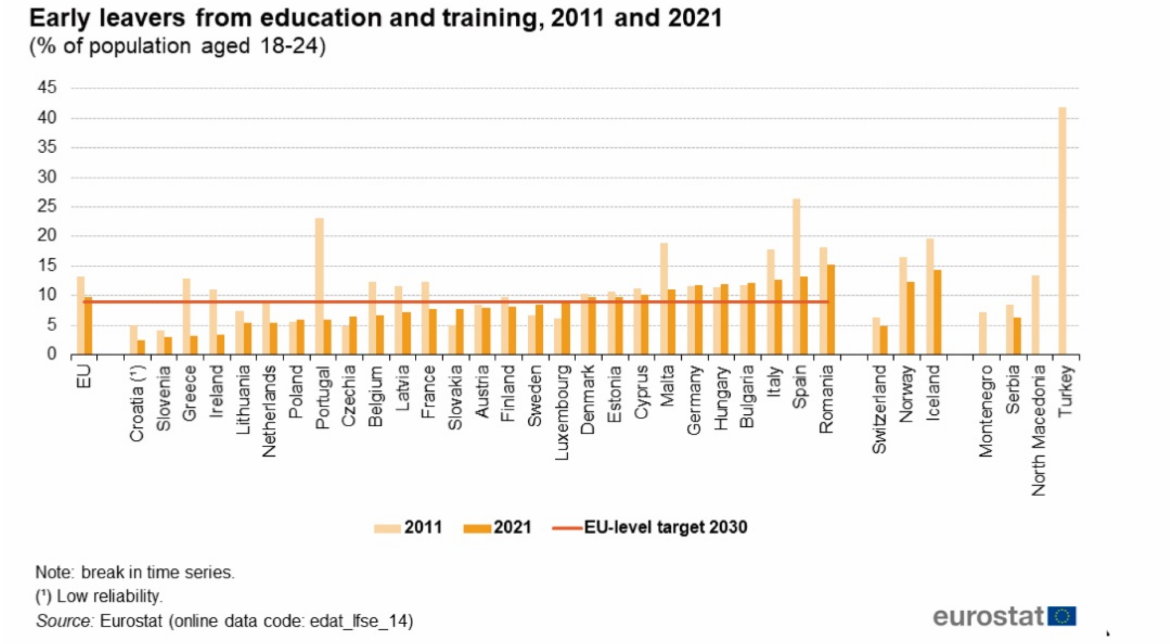
Graph 1. The average school drop-out rate in the EU region



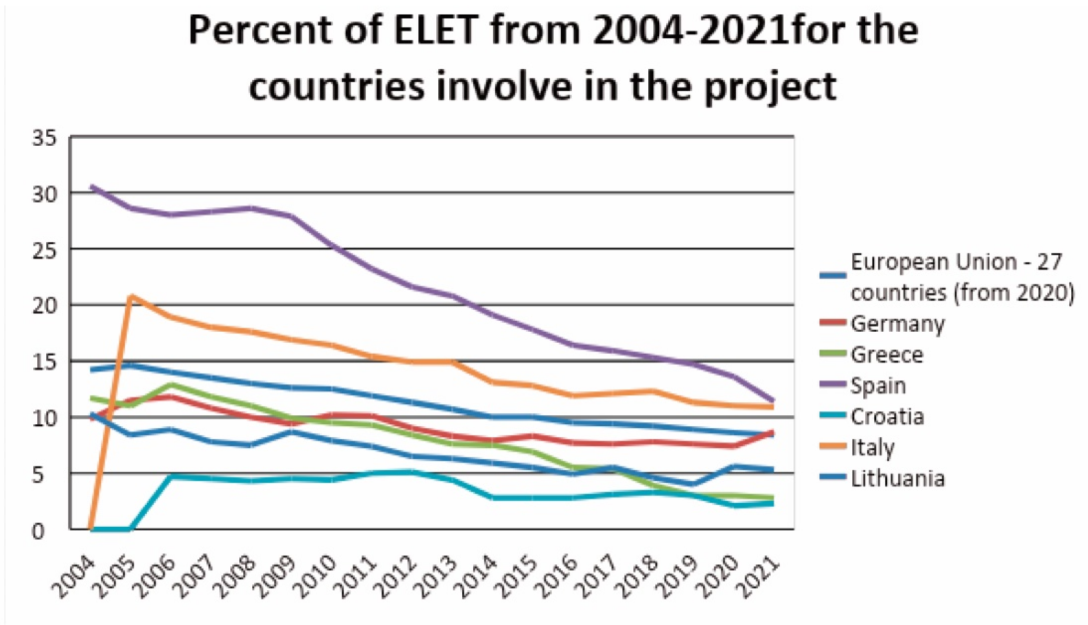
Source: Eurostat
https://ec.europa.eu/eurostat/databrowser/view/edat_lfse_01/default/table?lang=en

From the graph we can see that there was an increase in 2005 and since then it has been decreasing continuously. In 2020 the school dropout rate fell below the 10% target set by the EU.
A more detailed breakdown of school drop-out in 2021 compared to 2011 is shown in Figure 2.

Graph 2. Comparison of school drop-out from education and training in 2011 & 2021



As we can see from chart 3, in all countries the school dropout rate has dropped considerably after the actions taken. Few countries show rates above 10%.
Graph 3 shows the averages of school dropout in the countries participating in this Erasmus project.

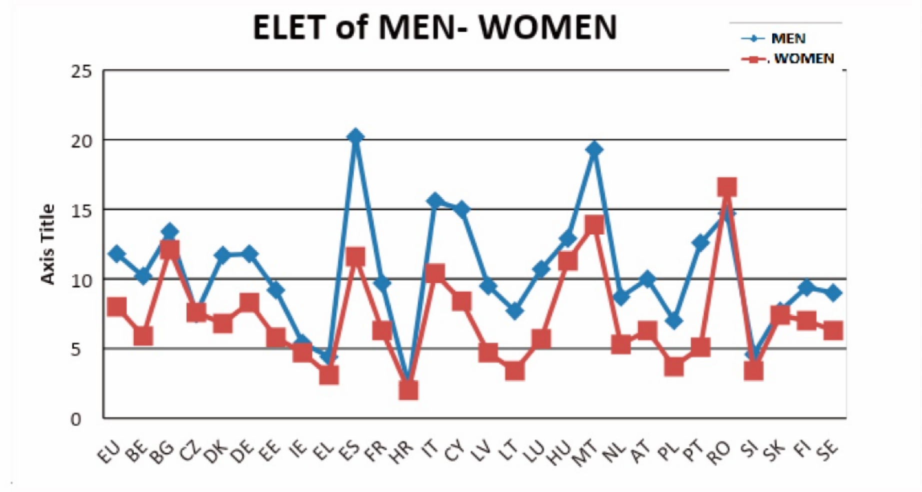


Source: Eurostat
https://ec.europa.eu/eurostat/databrowser/view/edat_lfse_01/default/table?lang=en

From graph 3 we can see that there is a downward trend in all countries involved, with a large drop in Spain below 50% and in Italy. The lowest levels occur in Croatia, followed by Greece.

Graph 4 shows the school dropout for boys and girls in the EU according to Eurostat statistics, for 2020.

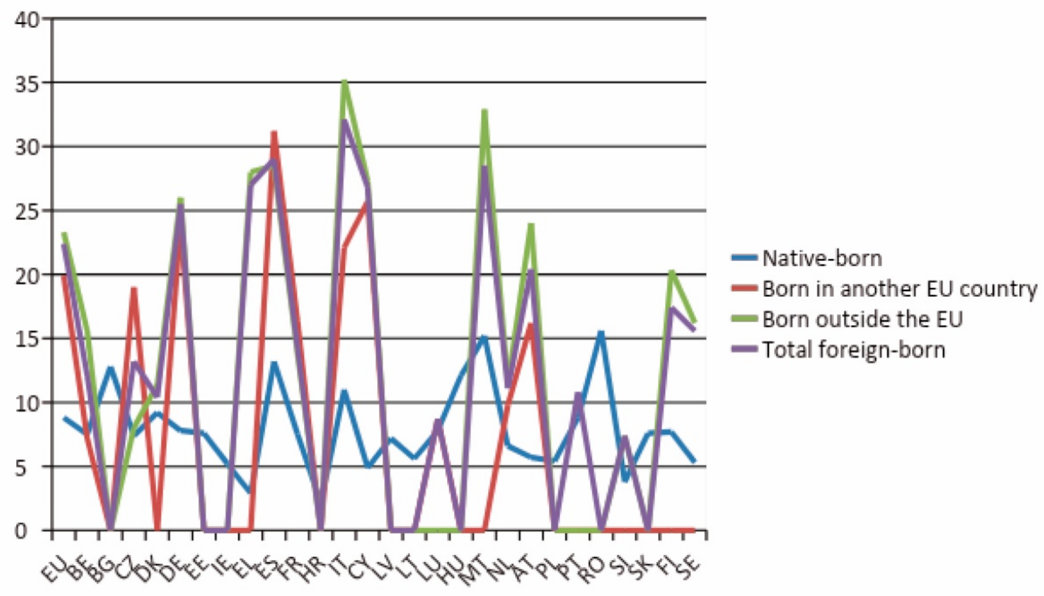
Graph 4. School drop-out rates for boys and girls for 2020 in the EU



Source: Eurostat, EU Labour Force Survey 2020. Online data code: [edat_lfse_02] and [edat_lfse_30].

There is a higher drop-out rate of boys than girls in EU countries. The only country with a higher drop-out rate for girls than for boys is Slovenia.
Research has shown that young people from other countries whose language of instruction does not coincide with their mother tongue have a higher rate of school drop-out. Graph 5 shows the statistics of those born in the country where they attend school, those born in another EU country and those born in non-EU countries.

Graph 5. School drop-out by country of birth for 2020 in the EU



Source: Eurostat, EU Labour Force Survey 2020. Online data code: [edat_lfse_02] and [edat_lfse_30].

The graph shows that a lower drop-out rate is observed among pupils born in the country they attend. A very high drop-out rate is observed among students that born in non-EU countries.

Conclusions - Observations

The common goal of all European countries is to respond to the competitive and ever-changing international economic environment. In this context, European societies are actively seeking to become 'knowledge and learning societies' by providing their citizens with adequate and quality education. At both international and national level, more comprehensive education and training, in addition to contributing to individual development, cohesion, professional and personal integration, provides economic security for all.

School drop-out must be a long-term political and economic commitment to be reduced , so it must be placed high on the political agenda. Ensure that children and young people are at the heart of all policies aimed at reducing early school leaving. Their voice must be taken into account when developing and implementing such policies.

Schools should be supported to develop enabling and supportive learning environments that focus on the needs of individual learners. Curricula programs must be more attractive. Prevention is often better than the cure. All of this requires the cooperation between parents and teachers. Substantial training and support for teachers is needed to introduce digital learning and gamification into their teaching, in order to make lessons more attractive.

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3.2 SPAIN.

The following study is an initiative promoted by the IES HermanosAmorós within the Erasmus+ programme that funds projects for the prevention of early school leaving with the aim of obtaining data on the processes that lead pupils aged 12 to 16 to leave school prematurely, their characteristics and the factors that influence the rates, in order to advance towards the development of projects and intervention programmes to reduce this problem.

The aim of the report is to explore and disseminate data that will help to provide as complete a picture as possible of early school dropout. To this end, data on school failure, truancy and access to the second stage of compulsory education, among others, will be taken into account, emphasisingon what various studies point out (Alfonso and Gabardá, 2015; Soler et al., 2021; Escarbajal, Izquierdo and Abenza, 2018), in that the truancy indicator in compulsory educational centres is one of the risk factors and is associated with the subsequent decision to drop out of school. In this line, the present study traces a relationship between truancy, school failure and early school leaving.

In this sense, it should be pointed out that the data that can be obtained for the municipality of Villena will be those that relate early school leaving to truancy, as these are the data on truancy that can be accessed at municipal level. This is why the research will try to analyse the early school dropout rate, as defined by official bodies, but incorporating other data such as the percentage of school failure, the level of school enrolment from 12 to 16 years of age and/or absenteeism data, the latter referring to the municipal scale.

This work is divided into two blocks. On the one hand, the conceptualisation of early school leaving is elaborated, defining the indicator as proposed by the official bodies that analyse the data on early school leaving, as well as its characteristics. On the other hand, and once the concept of early school leaving has been defined, it is essential to establish a conceptualisation of two other closely linked indicators and to have as complete a view as possible of the object of study, such as school failure and truancy, which will be reviewed in the specialised literature and defined with the aim of highlighting the close link between the three types of indicators and which ultimately mark the object of research. Within this first section, it is also of interest to establish a first approximation to the comparison between Spain and the countries of the European Union and to explain some of the existing differences between the countries.

The second section analyses the data with the indicators that have been established to understand the phenomenon of early school leaving and its relationship with the other variables. These data are shown at European, State and Autonomous Community level, and for each of the geographical scales, data are extracted from official bodies to provide the most complete analysis possible. At the municipal level, data is extracted on school absenteeism and school failure. With all of this, conclusions will be drawn which, on the one hand, compare how the rate behaves and its evolution and, on the other hand, the key aspects to be considered in order to define a strategy to reduce early school leaving in Compulsory Secondary Education for the municipality of Villena will be extracted.

Objectives.

- To carry out a review of the literature to define the concept of Early School Leaving and its characteristics in Spain and in relation to school failure and truancy.

- Obtain data from secondary sources on the characteristics of early school leaving and its evolution in Spain and in each of the seventeen Autonomous Communities.

- Obtain data from secondary sources from official bodies on the evolution of early school leaving in the countries that make up the European Economic Community.
- To extract from the data an analysis of the current situation of school failure and early school leaving, at regional, national and European levels.
- In the case of Villena, analyse the situation of early school leaving with data on the percentage of absenteeism and school failure in Secondary Education Centres.
- Draw conclusions in the light of the data extracted and analysed.

CONCEPTUALISATION OF EARLY SCHOOL LEAVING, SCHOOL FAILURE AND TRUANCY.

From official bodies and institutions[1] *early school dropout* is defined as the percentage of people aged 18 to 24 who have not completed upper secondary education and are not following any type of study-training in the four weeks prior to the interview conducted through the Labour Force Survey. Their highest level of education is level (0-2) of the CNED-201, which corresponds to pre-school, primary and lower secondary education, and they do not receive any education or training (formal and non-formal).

With regard to this definition proposed by official bodies, reference should be made to what Mª Teresa González González[2] (2018) points out in terms of the various definitions given to this indicator, giving greater importance to how its meaning is shaped in relation to how the analysis of the reality of early school leaving is approached, bearing in mind that there are multiple approaches and also various ways of dealing with this problem.

In this sense, and due to the fact that the age range from 18 to 24 years exceeds and exceeds the training cycle in which Secondary Schools, and in this case the IES HermanosAmorós, can act with the aim of preventing early school leaving, for the case of the present research and as has been pointed out throughout the document, it is of interest to link early school leaving in relation to those students who are still part of the compulsory education system but already have a certain degree of truancy within the school environment and at an early stage.Although it is beyond the scope of this research, it should be emphasised that higher levels of early school leaving are caused by multiple risk factors such as social, economic, educational, family and other contexts. In various documents and reports on the study of the problem, it is also pointed out that early school leaving is higher in populations with high levels of social and economic vulnerability (Eurydice, 2014), which ultimately increases social inequalities, so that strategies to address the challenge of early school leaving are being developed from an integrated educational perspective.

As several authors point out in the specialised literature (Newman et al., 1992; Finn, 1993; Wilms, 2000; Lehr, 2004), early school leaving does not occur suddenly; a pupil does not stop going to school from one day to the next and never come back. In this sense, a progressive process is pointed out, starting from various "disengagement" factors, which manifests itself in the truancy indicator and culminates in early school leaving. This concept of "disengagement" refers to risk factors within the academic and school environment, linked for example to disaffection with school and education that can be shown through repeated absenteeism, low grades, behavioural problems, etc.

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[1] For an official definition of the early school dropout indicator, the INE has been consulted at https://www.ine.es/uc/nJWJg1gx.

[2] González González, Ma. Teresa, *El absentismo y el abandono: una forma de exclusión escolar Profesorado*. Revista de Currículum y Formación de Profesorado, vol. 9, núm. 1, 2005, p. 0 University of Granada Granada, Spain.

This is how early school leaving has its precedent in the risk factor of truancy as an indicator to be considered in the first and second stage of secondary education and these two in turn are closely related to the school failure indicator. The higher the absenteeism at school, the higher the probability of school failure, which can lead to early school leaving.

The operative concept of *truancy,* and the most generalised once the literature on this phenomenon has been reviewed, defines truancy as the lack of attendance (justified and unjustified) by the pupil at his or her school post within the school day, this being a habitual practice. According to various studies reviewed, habitual is understood to mean absence from school for more than 25% of the school day.

According to the study "*Truancy in vulnerable contexts of* exclusion"[3] (2019), the level of truancy in Spain is among the highest in comparison with other OECD countries, the percentage of those who never miss school is 70%, well below the international average, which is 85%. In the aforementioned study, the authors indicate how truancy often has a direct impact on both school dropout and social exclusion. The same study refers to a 2014 OECD report, which concludes that Spain is one of the European Union countries with the worst figures in terms of school absenteeism.

As mentioned above, the relationship between absenteeism and early school leaving is that absenteeism focuses the data on students who are of compulsory school age and are attending the corresponding studies, while early school leaving refers in the studies and analysis to young people who no longer have access to post-compulsory studies. As José Ignacio Cruz Orozco[4] (2020) points out, "while the former is directly related to the right to education, or more precisely, to the non-fulfilment of this right, early school leaving is not located in the territory of rights and duties, but outside it*"* (Cruz Orozco, p. 124: 2020).

On the other hand, the links between early school leaving, absenteeism and school failure are clear, since a higher degree of absenteeism leads to a higher incidence of school failure and the impossibility of obtaining school certificates, which in turn leads to early drop-out from post-compulsory education.

Finally, according to the report "*Map of truancy in Spain 2021*"[5] , the definition of *school failure* refers to a situation in which students try to achieve the minimum objectives set by the educational institution, in this case compulsory secondary education, but drop out without having achieved them. They fail and obtain from the education system a certificate of having completed compulsory secondary education, but do not obtain the diploma of graduation in Compulsory Secondary Education (p. 33: 2021). It could be said, according to the specialised literature, that school failure begins during compulsory education, with the risk factors and the 'disengagement' described above, and continues after compulsory schooling, referring to pupils who drop out of school at the age of 16. On the other hand, international specialised literature indicates that school failure is indistinct

[3]Escarbajal Frutos A.; Izquierdo Rus T. and Abenza Pastor B. (2019). *Truancy in vulnerable contexts of exclusion. Profesorado, Revista de Currículum y Formación Del Profesorado*, 23(1), 121-139. https://doi.org/10.30827/profesorado.v23i1.9147

4 Cruz Orozco, J. I. (2020). *Absenteeism at school in Spain. Datos y reflexiones*. Contextos Educativos. Revista De Educaci ón, (26), 121–135. https://doi.org/10.18172/con.4443

[5]Soler, Ángel and Martínez-Pastor, Juan-Ignacio and López-Meseguer, Rafael and Valdés, Manuel T. and Ángel, Miguel and Sancho Gargallo, Miguel Ángel and Morillo, Beatriz and Cendra, Livia (2021). *Mapa del abandono educativo temprano en España*. EuropeanFoundationSociety and Education. Madrid.

from the dropout rate to refer to students who leave the education system without completing upper secondary education (Pérez-Esparrells and Morales; 2012).[6.]

In short, and for the analysis that we want to establish here, although the data that exist in general and with greater precision are the early school dropout rates in the case of Spain and the OECD member countries with the definition established by the official bodies, we will also take into account indicators linked to school failure for the Autonomous Communities, and above all and for the case of Villena, school absenteeism and school failure, in the ages between 12 and 15 years old. In any case, as far as possible and on the basis of the data obtained from the sources reviewed, the situation at local level in terms of school failure and the possible trend of subsequent early school leaving should be explored, knowing beforehand where the levels of this problem are at European and Spanish level.

METHODOLOGY OF THE STUDY.

In order to prepare the analysis carried out in section five of this report, the exploration and subsequent exploitation of secondary data sources from official institutions such as the INE, the European Commission-OECD and the Ministry of Education and Vocational Training was carried out, as well as the collection of data already elaborated in reports and documents produced by official bodies such as the University of Valencia, the Valencian Institute of Economic Research, the Sociological Research Review (REIS) and the European Education and Culture Executive Agency, the latter being those which can offer additional interpretations and conclusions which contribute knowledge to the research.

The data that make up the analysis of the Early School Leaving Indicator (ELE) are extracted, both the rate already provided by the INE, as well as those other variables that explain and complete the analysis of Early School Leaving, with special emphasis on those data that can establish a relationship with this indicator, to the extent that these data can be accessed on the scales of analysis. The data referring to school failure in secondary education, the evolution of schooling from primary to secondary, or absenteeism in the case of secondary schools in the municipality of Villena, as well as socio-demographic variables of distribution by sex and age, among others, will be taken as a reference to complete the analysis and thus obtain a picture of the specific situation of the object of research, such as school failure and absenteeism in the first and second stages of compulsory secondary education, to understand the possible degree of incidence in early school dropout.

The methodology of the study includes qualitative research with the application of the interview technique, and that this was carried out with the Municipal Team of Absenteeism of Villena, with the aim of completing the study and obtaining a look as close as possible to the object of research. The technical team of Absenteeism is the institutional body in charge of collecting data on truancy in the municipality since 2018, and it is also the body that currently monitors cases of truancy in the town, carrying out coordination tasks with entities linked to the area of Social Services, the Juvenile Prosecutor's Office, Local Police or the courts of Villena, in order to articulate responses at all levels, whether educational, family, municipal or legal.

3.2. Secondary data sources

[6]Pérez-Esparrells, Carmen , Morales Sequera, Susana *El fracaso escolar en España: Un análisis por Comunidades Autónomas*. Revista de Estudios Regionales [online]. 2012, (94), 39-69 [Accessed 20 October 2022]. ISSN: 0213-7585. Available at: https://www.redalyc.org/articulo.oa?id=75524558002

- Statistical data
  - INE: https://www.ine.es/uc/QU3MkyNo
  - EducaBase: http://estadisticas.mecd.gob.es/EducaDynPx/educabase/index.htm?type=pcaxis&path=/laborales/epa/aban&file=pcaxis&l=s0
  - European Commission-OECD: https://op.europa.eu/webpub/eac/education-and-training-monitor-2021/es/chapters/leaflet.html
  - Eurostat: https://ec.europa.eu/eurostat/databrowser/view/edat_lfse_14/default/table?lang=en
  - Villena Municipal AbsenteeismTeam.

- Reports and documents
  - Ministry of Education and Vocational Training: https://www.educacionyfp.gob.es/inee/indicadores/sistema-estatal/ultima-edicion.html
  - European Foundation Society and Education: https://www.sociedadyeducacion.org/noticias/presentado-el-mapa-de-abandono-educativo-temprano-en-espana/
  - European Executive Agency for Education and Culture, Eurydice, Tackling Early Leaving from Education and Training in Europe : Strategies, Policies and Measures, Publications Office, 2015, https://data.europa.eu/doi/10.2797/483164

SCHOOL FAILURE AND EARLY SCHOOL LEAVING FROM A COMPARATIVE PERSPECTIVE.

As mentioned above, it is of interest to extract from the data for comparison the behaviour of the indicators linked to school failure and early school leaving, since these are the data that both the specialised literature and the official bodies work on to tackle the problem, but above all they are the data that can offer a comparative image, where it is possible to relate from the same indicator what is happening at European level and at state and regional level. In this section, with the aim of making this comparison, it is first of all of interest to contextualise the Spanish situation with respect to the European situation in terms of levels of failure and early school leaving.

Until 2020, the *Education and Training Strategic Framework ET2020*[7] was the strategic framework followed by the European Union for the successful development of education and training systems in the Member States. This framework built on the achievements of its predecessor, the *Education and Training Work Programme ET2010*. The primary objective of the *ET2020* framework was to further support the development of education and training systems in the Member States and set out four strategic objectives:

> *"1) Making lifelong learning and mobility a reality, 2) Improving the quality and effectiveness of education and training, 3) Promoting equity, social cohesion and active citizenship and 4) Enhancing creativity and innovation, including entrepreneurship at all levels of education and training"*. (Council Conclusions of 12 May 2009 on a strategic framework for European cooperation in education and training, ET 2020, 2009).

Within this framework document and having as one of the objectives "*the improvement of training to move towards a society with a high social capital, and thus facilitate greater access to the labour market*" (ET; 2020), it was sought, among the strategies, to reduce the high percentage of early school leavers that had a great impact on all regions of the EU-27 and on the most vulnerable

[7] Eurydice Spain, *Strategic Framework for Education and Training ET2020*. See: https://www.educacionyfp.gob.es/mc/redie-eurydice/espacio-europeo-educacion/contexto-politico/antecedentes/et2020.html

population. The combination of low education and social and economic vulnerability factors led to a worsening of the processes of social exclusion, which ultimately deepened the difficulty of accessing the education system and, above all, of accessing middle-level education. This high percentage derived from a series of risk factors linked to school failure, which ultimately resulted in a high percentage of the population dropping out of school and completing only basic education, which made it difficult to enter a more qualified and stable labour market.

With these premises, in 2003 the Council of the European Union passed the resolution on "*Making school an open learning environment to prevent and combat early school leaving and disaffection among young people and to promote their social inclusion*". This resolution incorporates in the strategy the development of a series of mechanisms for prevention and early detection of people at risk, which, as the Resolution points out:

> *"To develop a framework for benchmarking strategies to promote social inclusion and thus the employability of young people themselves, by removing the obstacles that stand in the way, including early school leaving and other forms of disaffection among young people".(Resolution (2003/C 295/02) of the Council of the European Union of 25 November 2003).*

Already in 2010, the EU-27 shows high early school dropout data with an average of 13.8%, where Spain was one of the regions with the worst data, accumulating a total of 28.2% early school dropout rate. This strong imbalance between the EU-27 average and Spain implied the achievement of different objectives in the reduction of the rate by 2020. On the one hand, and for the countries with the lowest rate, the objective was set to reduce the rate to 10%, and for Spain and countries with a rate similar to that of Spain, the objective was set to reduce it to 15%.

The Spanish Social Economic Council in the Report published in 2022 already incorporates updated data on school failure and early school leaving from a comparative perspective, indicating that Spain still maintains low positions within the EU-27 and in relation to the proportion of 20-24 year olds with an upper secondary level of education or enrolment in vocational training, concluding that in this area of education, progress has not been sufficient to reach the average levels in the European Union (p. 364: 2022).

Both in thisreport and in othercurrentdocuments and reportsreviewed(Consejo Económico y Social, "*Memoria sobre la situación socioenconómica y laboral de España en 2021"* CES, Departamento de Publicaciones, NICES: 821-2022. Memorias Collection. Number 29.), it is pointed out that from a comparative perspective, early school leaving in Spain is a cause for some concern because although the levels have been reduced with respect to the previous decade, they are still higher than the European average. In addition, the specialised literature points out that the percentage of the population with basic education in Spain has always been higher than in the vast majority of EU-27 countries, together with the lower percentage of the population with post-compulsory secondary education[8] .

The problem for Spain with respect to Europe lies in the transition from basic or lower levels of education to medium levels of education, as the percentages of the population with higher education and university levels in Spain and in comparison with Europe already show above average percentages. For this reason, at a general level and in the EU, the strategy has been to improve the population's access to qualified medium-level studies, where one of the indicators to be reduced are the high rates of school failure and early school dropout in secondary education and intermediate vocational training. As can be seen from the literature reviewed, not achieving an average educational level linked to training in post-compulsory secondary studies such as the Baccalaureate or intermediate vocational training indicates to a certain extent that the risk factors associated with school failure have operated and had an impact on the training process in the stages corresponding to compulsory education.

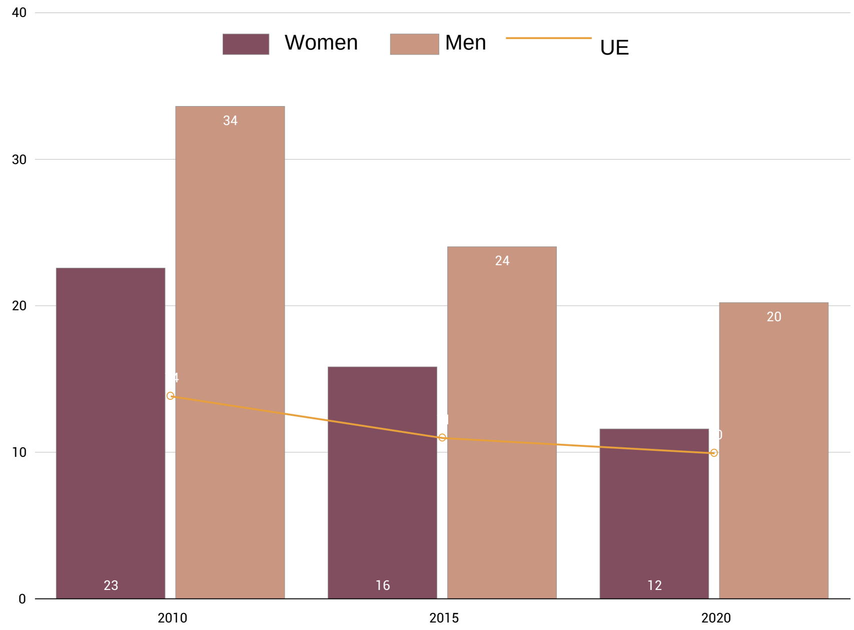
It is for this reason that since 2010 the European 2020 Strategy for growth and employment has included among its specific recommendations for Spain the reduction of the early school leaving indicator with the aim of reducing the difficulties of access to the labour market, since a higher qualification of the population at intermediate educational levels, especially the attempt to complete upper secondary education, has an impact on a greater probability of access to the labour market. It is here that the focus of the research is on the transition from the 1st to the 2nd stage of Secondary Education and it is here that the level of the percentage of the school-age population that does not graduate from Secondary Education should be noted, recognising that this may lead to early school leaving and, therefore, to greater difficulty in accessing studies at an intermediate level of education.

5.1. Early school leavers and school failure in Europe.

This analysis of the characteristics and situations of *Early School Leaving* (ESL) in Spain and the European Union contains, as indicated in the Methodology section of the study, a selection of data processed and published by both national and international organisations. The indicators set by the European Union in its different strategies and implementation of education and training policies are used as a point of reference, since changes in ESL at national, regional and local level are closely linked to EU education policies.

CHART 1.

Evolution of the Early School Leaving rate by gender, in Europe and Spain (%)



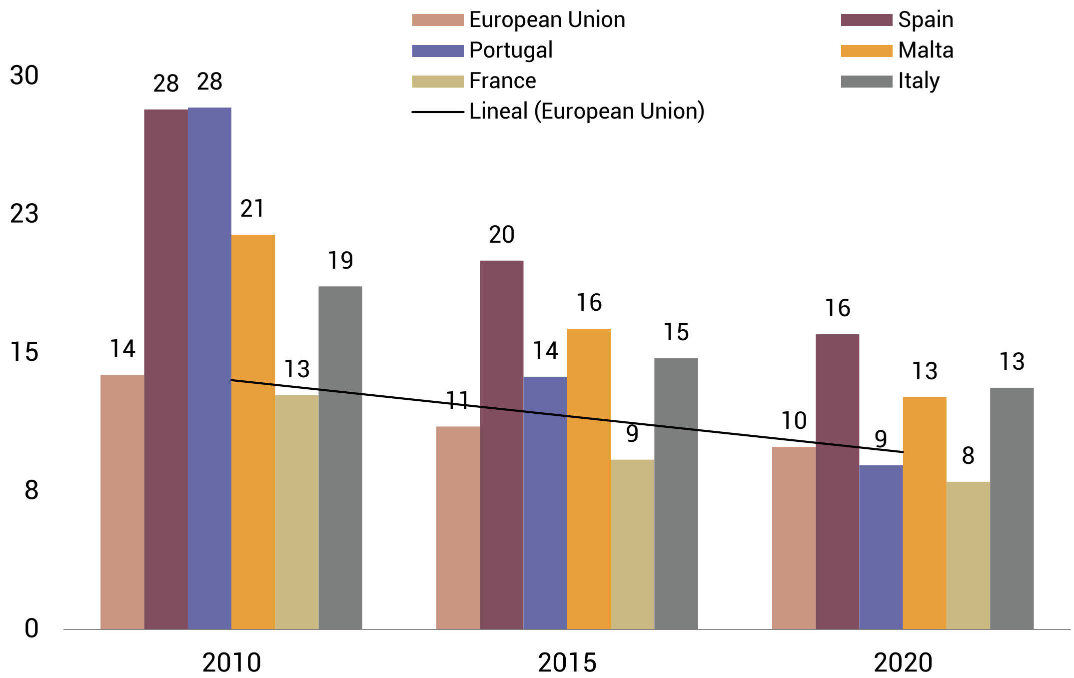
Source: Own elaboration based on data extracted from the Ministry of Education and Vocational Training.

As can be seen in Graph *1: Evolution of the Early School Leaving rate by gender, in Europe and Spain, while the* EU-27 average reduced the dropout rate by 3.9 p.p. from 2010 to 2020 - thus meeting the target set in the European strategy to reduce the rate to 10% in 2020 - in the case of Spain, even though the rate was reduced by 12.2 p.p. from 2010 to 2020, it was not enough to reach the EU target of 15% set for Spain in 2020.

Although the rates have been catching up, Spain still has some way to go to reach a level similar to the EU-27 average by 2020. This greater difficulty for Spain to reduce the early school leaving rate and thus reach the levels set for the EU-27 is due, to a certain extent, to the fact that already in 2010 there was a large initial difference between the European and Spanish averages, with the rate in 2010 in Spain being very high compared to the rest of the countries, with Portugal and Malta being those that were on a par with the Spanish case with 20% above the average for European countries in the same year. As can be seen in *Graph 2: Early dropout from education and training for the EU-27 countries*, Portugal in 2010 has a rate equivalent to that of Spain in 2010 (28.3%) and they did manage to reduce it in just five years by 14.6 p.p., being already on the threshold of the established target in 2015 and surpassing it in 2020 with a rate of 8.9%, thus equalling the EU-27 average.

CHART 2.

Early school leavers in education and training by EU27 country



Source: Own elaboration based on data extracted from the Ministry of Education and Vocational Training.

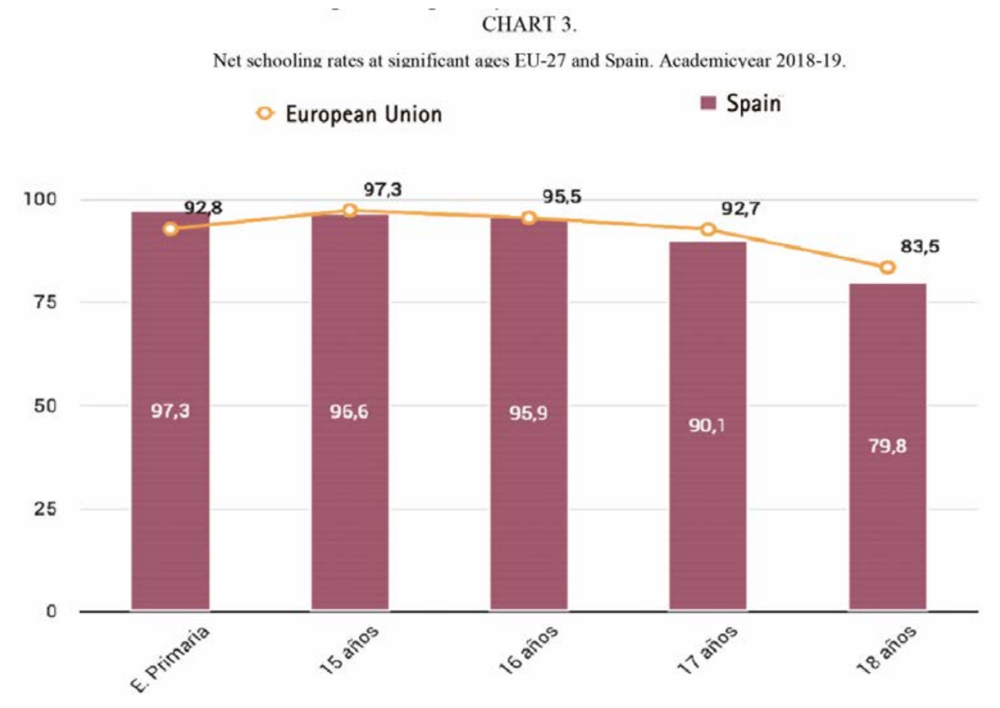
As can also be seen in Figure *1*, there are significant differences in terms of the gender of the early school leaver, both at EU-27 level and in Spain and other countries. Although there is a downward trend for both sexes (lower percentage of early school leavers over the years), the percentage of early school leavers among males is higher than among females. This is to some extent due to the fact that firstly, in 2010, males have a higher proportion of early school leavers than females and for all EU-27 countries. On the other hand, the trend in relation to the sexes and by country from 2010 to 2020 is that for all countries the drop-out rate for females decreases, while the drop-out rate for males increases in some countries, such as Bulgaria, Austria, Hungary or Luxembourg. Therefore, with regard to gender, the differences are significant, indicating that the incidence of early drop-out has a greater impact on males than on females. Among the explanatory factors we can find the labour market, in relation to the fact that the link of women to a labour market with a low qualification level is weaker, i.e. it is more difficult for women to access a low qualified job than for men, so that they tend to delay to a greater extent their exit from education and training, especially in the compulsory stages, which can lead to a lower rate of early dropout.

It is interesting in relation to the drop-out rate and recognising, as pointed out in Section 2 *"Conceptualisation of early school leaving and school failure"*, that drop-out does not arise suddenly but is rather the result of a process linked to school failure, together with other risk factors. It should be noted, with the data available at EU-27 level, how the *Net Enrolment Rate behaves*, which shows the percentage ratio between the pupils of the considered age who attend a specific training cycle with respect to the total population of that age (INE, 2022).

Thanks to the net enrolment rate, it is possible to observe the changes in the percentage of pupils who are in the education system at non-compulsory levels of education. In turn, and as can be seen in *Graph 3: Net enrolment ratios at significant ages EU-27 and Spain. Academic year 2018-19*, the ages that comprise Primary Education and the First Stage of Secondary Education, up to the age of 15, are the ages where schooling is almost 100%, with values between 96.5% and 97.3%. In these stages, both for the EU-27 and for Spain, the percentages are on a par, with very similar percentages. Subsequently, when the threshold of 15 years of age is passed, the net percentage of schooling decreases until the age of 18, where it falls by 16.8 p.p. in the case of Spain and by 13.8 p.p. for the EU-27 average, being the ages corresponding to the second stage of compulsory secondary education and the transition to post-compulsory education, where the greatest decrease occurs. In other words, as age progresses, there is a disengagement that begins in the first stage of compulsory secondary education and intensifies in the second stage of compulsory secondary education and the transition to post-compulsory education.

CHART 3.

Net schooling rates at significant ages EU-27 and Spain. Academicyear 2018-19.



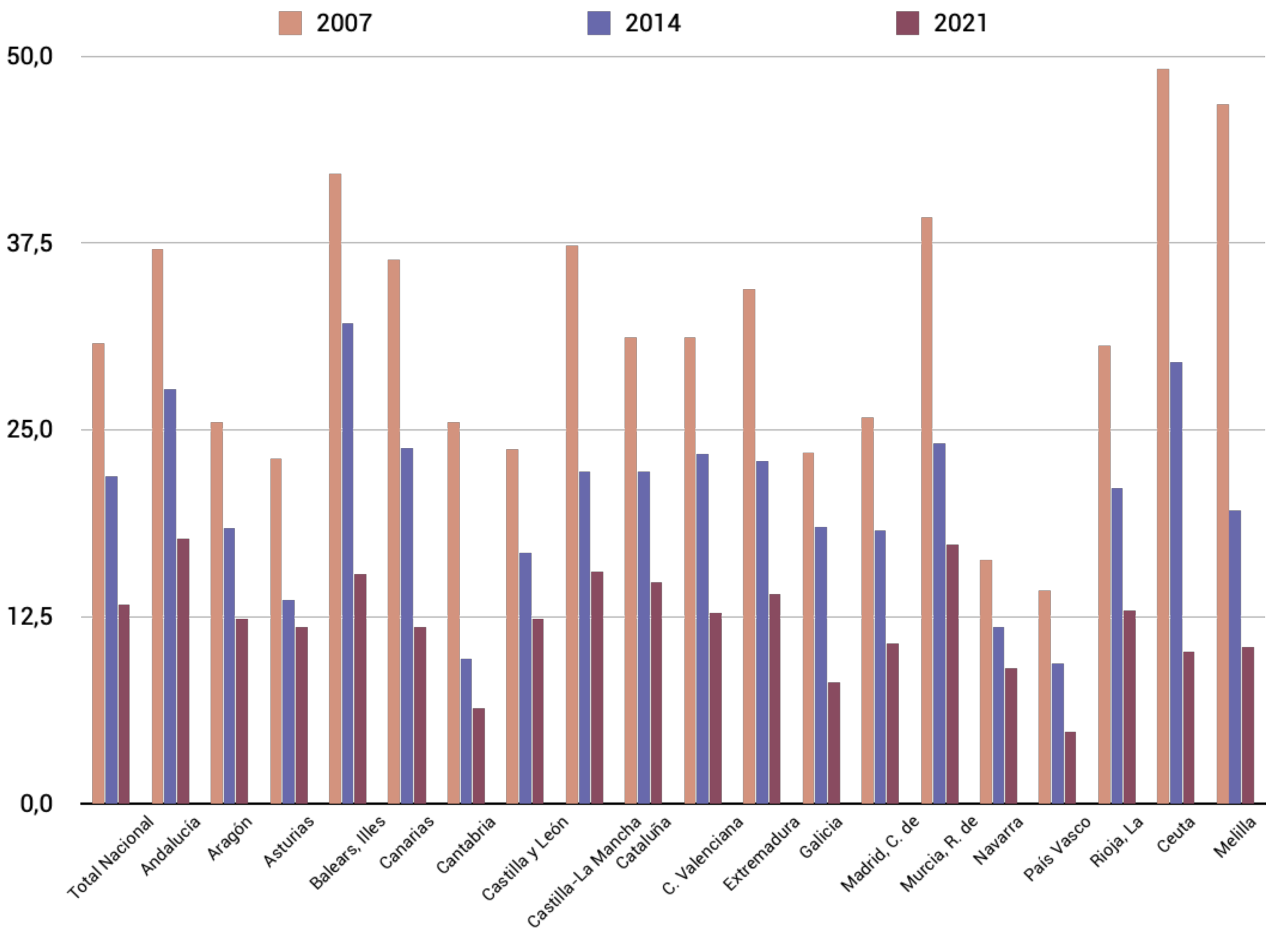
SOURCE: Compilation based on data extracted from the Ministry of Education and Vocational Training from the Labour Force Survey (European Labour Force Survey) - Eurostat - Information as of 18 October 2021.

5.2. Early school leavers and school failure in Spain and the Autonomous Regions.

Once we have analysed how the early school dropout rate behaves in Spain and in relation to the EU-27, recognising that the problem, as has been indicated throughout the document, is linked to school failure in the compulsory secondary education stage, which leads to subsequent early school leaving. It is interesting to know how this problem behaves in the different Autonomous Communities, and whether it validates and reinforces one of the theses put forward and which arises in the comparison with the EU-27, which is that greater school failure, understood as not having passed the second stage of compulsory secondary education, entails a greater probability of subsequent early school dropout. This process of "disengagement" from the compulsory education system is distributed unequally between men and women, with men having a higher proportion of early school leavers than women.

CHART 4.

Early School Leavers in the population aged 18 to 24 years by Autonomous Community and period

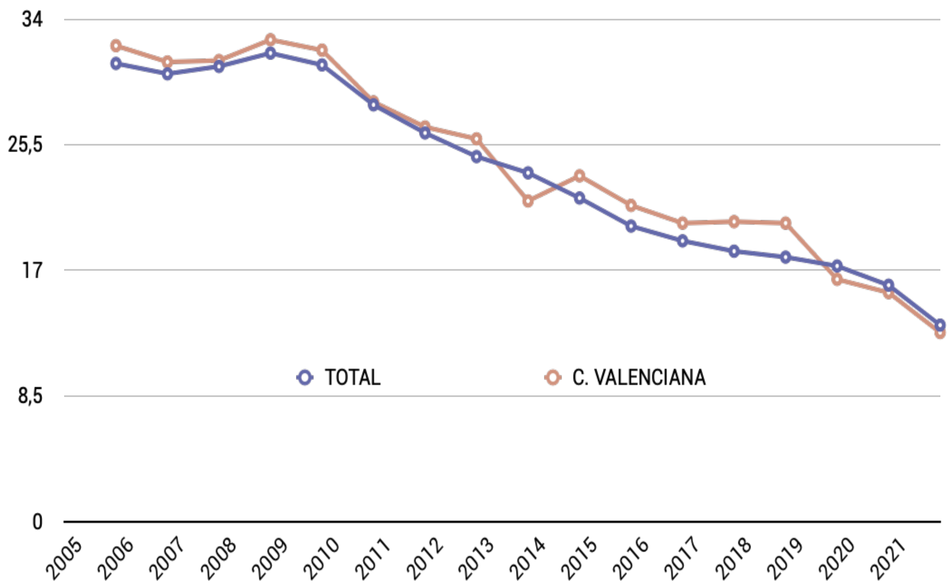


Source: Labour Force Survey. INE.

Firstly, as already observed in the data on early school leavers for Spain and the EU-27, Spain in 2020 had a drop-out rate of 16%, with the male gender 10 percentage points higher than the female gender. If we look at *Graph 4: AET of the population aged 18 to 24 by CCAA and period* from 2015 to 2021, the early school leaving rate has been decreasing for all the Autonomous Communities, being the case of Andalusia (17.7%), Balearic Islands (15.4%), Community of Valencia (12.8%), Murcia (17.3%), Ceuta (10.2%), Melilla(10.5%) or Canary Islands (11.8%) the ones that have had a greater decrease reducing it in some cases, such as Ceuta, by 20 p.p. from 2015 to 2020. Autonomous Communities that in 2015 exceeded the Spanish average of 20% school dropout rate for that year, currently and according to INE data for 2021, are in some cases, such as the Valencian Community, below the Spanish average with 12.8%. In this respect, it should be noted that, as referred to in the specialised literature, the strong disparity in data between the Autonomous Communities with respect to the early school dropout rate is largely due to: 1) The diversity of factors from the social context that operate in the causes of the problem, such as the average family disposable income, the family context, the family educational level, etc. 2) The decentralisation of competences in education transferred to the Autonomous Regions, which translates into disparity in terms of the investment they themselves devote to education and training, and 3) Territorial diversity in the labour market, linked to a greater or lesser level of education and training. All these elements, among others, will have an impact on a higher or lower percentage in terms of the early dropout rate for each of the Autonomous Communities.

CHART 5.

Evolution of Early School Leavers in the Valencian Community and Spain (%)

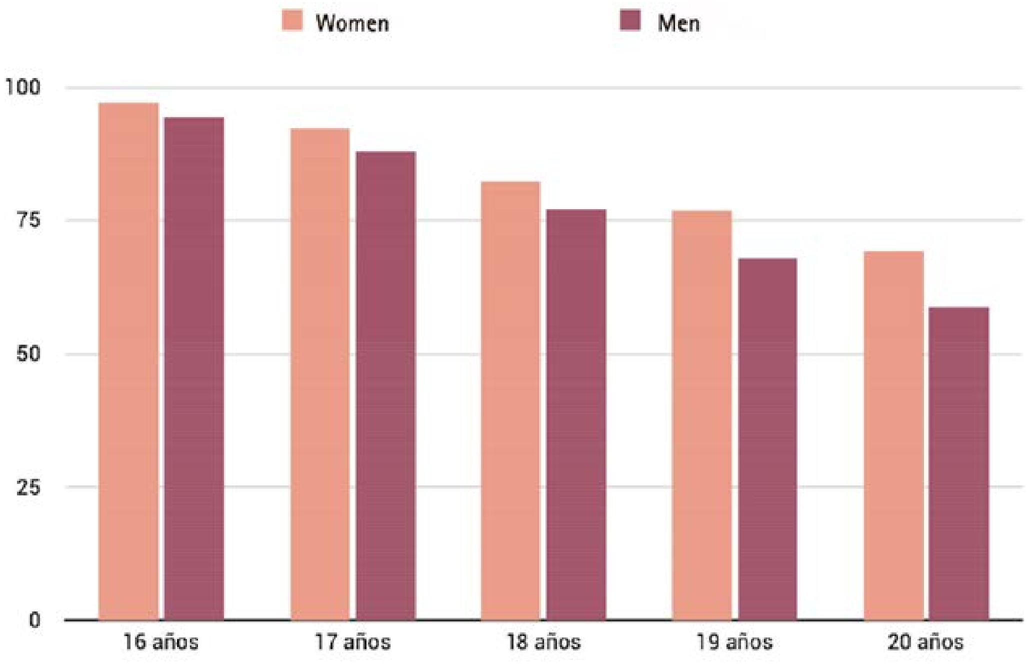


Source: Labour Force Survev. INE.

Specifically, the evolution of the Valencian Community, as can be seen in *Graph 5: Evolution of the AET in the Valencian Community and Spain (%)* between 2007 and 2021, is a clear decrease with a reduction of 18.4 p.p., equalling the national total (17.5 p.p.). If we analyse the data according to the economic cycles of expansion and economic crisis, we can see that from 2005 to 2008 the rate increases by 4 p.p. between both years, reaching the period of economic crisis and recession 2009-2013 the rate of early school leavers in the Valencian Community decreases by 10.2 p.p. The following period, from 2014 to 2021, the rate of early school leavers in the Valencian Community decreases by 10.2 p.p.The following period, from 2014 to 2019, follows the same trend as the previous one, although with upturns; the rate manages to decrease between both years, 7 p.p. Already in 2020 and with the arrival of COVID-19, the data of the Valencian Community are very close to the total for Spain. In this sense, and with respect to the 2008 crisis, it is possible to confirm another of the theses put forward in the literature reviewed, which is that with greater economic expansion, early school leaving becomes more acute and when the economy contracts and there is a crisis linked to the labour market, as occurred in 2008. The withdrawal of the population from the educational stages, especially post-compulsory education, is delayed and a reduction in the early school dropout rate is observed. In the case of the Valencian Community, therefore, this economic factor has been one of the factors that may have had an impact on the problem.

CHART 6.

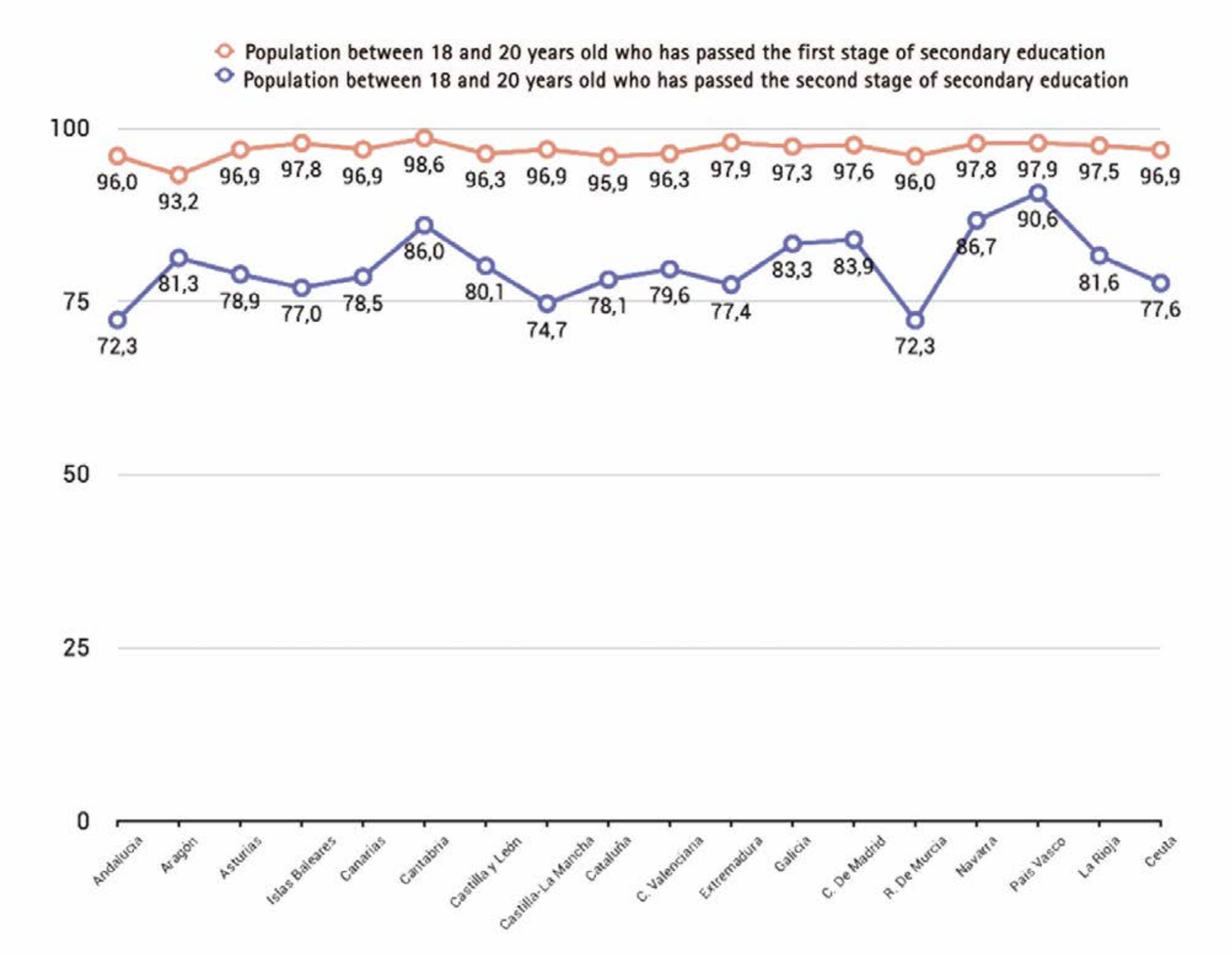
Net enrolment rates by age and sex. Academicyear 2019-2020 (%).



Source: Own elaboration based on data extracted from INE.

In order to have a more specific analysis of the problem on a national scale and to delve deeper into what has been called the process of "disengagement" from the education system, it is of interest to know how the *net enrolment rate* behaves, above all in the transition from compulsory secondary education to post-compulsory secondary education. The INE concludes, in view of the latest data on net enrolment rates in Spain, that it is from the age of 16 and 17 that net rates decrease. In relation to this, the female rates are higher than the male rates, which means that, as was pointed out for the Early School Leavers data, males leave the education system earlier than females. In addition, at 16 years of age, the theoretical age of post-compulsory education, there is a higher participation of females than males. It is in post-compulsory secondary education, and according to data from the 2019-2020 academic year, when the net enrolment rate of females at 16 years of age (93.6%) exceeds that of males (92.0%). At the age of 17, the difference in the rates is higher, 88.5% for females and 84.7% for males. It can be observed in a generalised manner that the rates are considerably reduced in the transition from compulsory education to post-compulsory education for both sexes and that schooling progressively decreases until the stages of university education.

In the case of the Valencian Community, it can be observed, as shown in *Graph 7: Net enrolment rates from 16 to 24 years of age in the ValencianCommunity*, that in general terms, the net enrolment rate decreases as the ages corresponding to intermediate and post-compulsory studies advance. It can be seen from the data, both at State level and by Autonomous Community, that for the Valencian Community there is also a progressive decrease in school enrolment at the ages that comprise the transition from Compulsory Secondary Education to post-compulsory Secondary Education.



Source: Own elaboration based on data extracted from INE.

If reference is made to *Graph 8: Population aged 18-20 having passed 1st Stage of Secondary Education by Autonomous Community (%) Year 2021*, and *Population aged 20-29 having completed at least 2nd Stage of Secondary Education by Autonomous Community (%) 2021*, it can be observed that school failure is once again located in the course of the stages of Compulsory Secondary Education, where the proportion of the population that should have passed the Second Stage of Compulsory Secondary Education is reduced with respect to the levels that were present in the First Stage of Compulsory Secondary Education. There are fewer graduates than would be expected according to the population that started Compulsory Secondary Education, and this decrease occurs in the transition from one stage to the other. As can be seen in the data analysed above, the problem worsens as the population moves closer to post-compulsory studies, leading finally to early school leaving.

While for the bulk of the Autonomous Communities in the First Stage of Compulsory Education there are no strong differences in terms of the population that has completed at least this first stage of secondary education, the same is not true when looking at the data for the Second Stage of Secondary Education, here the data show differences between Communities of a maximum of 18.6 p.p., between the Community with the highest number of population with completed Second Stage of Secondary Education (Basque Country) and the Community with the lowest percentage of population with completed studies (Andalusia). In the case of the Valencian Community, the population that has completed the Second Stage of Compulsory Secondary Education stands at 79.6%, 0.8 p.p. above the average for the Spanish average of 78.8%, but below the four

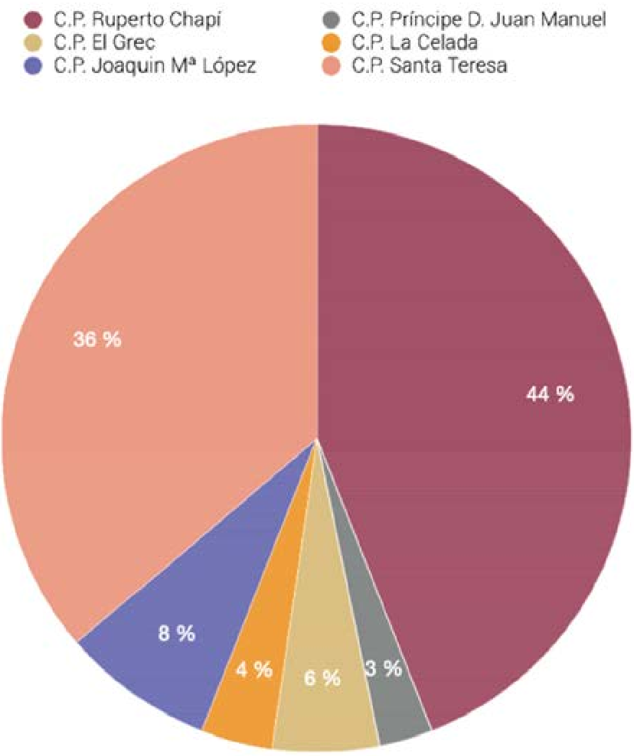
Autonomous Communities that exceed the average: the Basque Country (90.6%), Navarre (86.7%), Cantabria (86%) and Madrid (83.9%).

5.3. Situation of early school leaving in relation to absenteeism and school failure in the secondary schools of Villena.

For the purpose of the research, it is of interest to highlight the aforementioned fact that there are processes of "disengagement" that occur and worsen in the development of secondary education and among the risk factors that have to do with this process of "disengagement". School absenteeism is a datum that has been accessed at a local level and for the municipality of Villena. In order to analyse the problem in the municipality of Villena, first of all, we will try to present the data that the Municipal School Absenteeism Team has been able to collect, data referring to, on the one hand, the situation of absenteeism in the three Secondary Schools in Villena, namely: IES Hermanos Amorós, IES Navarro Santa Fé and IES Las Fuentes. On the other hand, the level of school failure, understood as the population that has not finished and has not obtained the diploma of graduation in the studies of Compulsory Secondary Education[9] . With all this and complementing the qualitative information gathered in the meeting held with the Municipal School Absenteeism Team, we proceed to establish an analysis of the problem on a local scale.

CHART 9.

Cases of truancy by public primary school, 2021-2022 school year(Totals).



Source: Prepared by the authors based on data provided by the Villena Municipal Team for School Absenteeism. 2022

As has been explained throughout this report, the problem of early school leaving is a problem that begins in compulsory education and has among its causes certain risk factors that have an impact on the educational process of pupils and finally lead to a greater risk of abandoning the education system, not only making it difficult to access post-compulsory education, but also leaving the educational process at a basic educational level without completing intermediate level studies in some cases. Furthermore, as stated in the literature reviewed[10] , this problem is concentrated in population groups with high percentages of socio-economic vulnerability, which in turn has a serious impact on the increase of social exclusion factors.

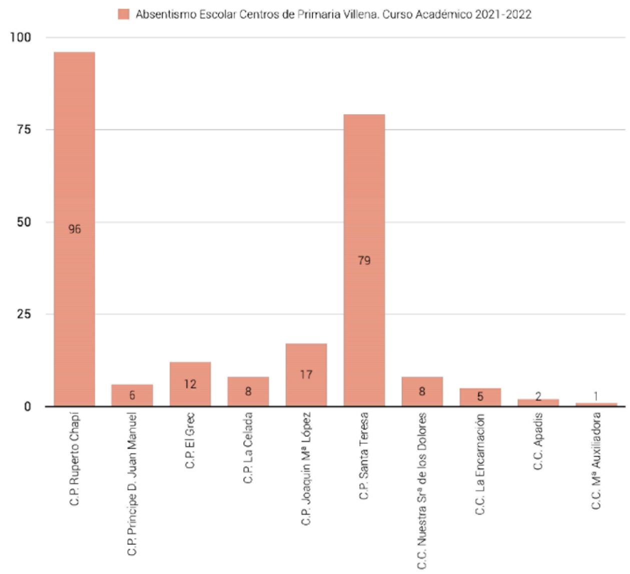
Firstly, with regard to the educational structure, it should be noted that the municipality of Villena currently has a total of 13 educational centres, of which 6 are Primary Education Centres, 4 are centres that combine primary and secondary education as they are subsidisedcentres, and 3 are Compulsory Secondary Education Centres. Of the primary schools, according to information provided by the Municipal School Absenteeism Team, there are two that concentrate a population with a high degree of vulnerability, namely the Santa Teresa Primary School and the RupertoChapí Primary School. This concentration of vulnerable population in two of the six centres is due, among other factors, to the socio-spatial segregation that exists in the municipality of Villena between the urban centre and the neighbourhood of San Francisco[11] , a neighbourhood with high percentages of social, economic and urban vulnerability with high rates of unemployment, families with low levels of education, at risk of poverty and a chronification of certain factors of socio-urban marginality; degraded urban park, civic insecurity, poor state of facilities and underutilisation of public services, this being the neighbourhood where the Santa Teresa Primary School is located and the RupertoChapí Primary School next to it.

According to the data provided by the Municipal School Absenteeism Team, there is a greater concentration of absenteeism in the two reference schools in the San Francisco neighbourhood, with the Santa Teresa Primary School, with one line per year, concentrating a total of 73 cases for the 2021-2022 school year, and the RupertoChapí Primary School, with two lines per year, concentrating a total of 93 cases for the same school year.

When we look at *Graph 10: Cases of truancy by Primary Education Centre, 2021-2022 academic year*, this same data in the Concerted Centres that bring together Primary Education and compulsory Secondary Education, it can be seen that there is a strong imbalance in the rates of truancy according to the type of centre in the municipality of Villena, with public educational centres and above all those located in vulnerable neighbourhoods being those that bring together the highest proportion of risk factors associated with early school leaving, with truancy being one of the data that reflects this problem at an early stage.

CHART 10.

Cases of truancy by Primary Education Centre, School Year 2021-2022 (Totals).



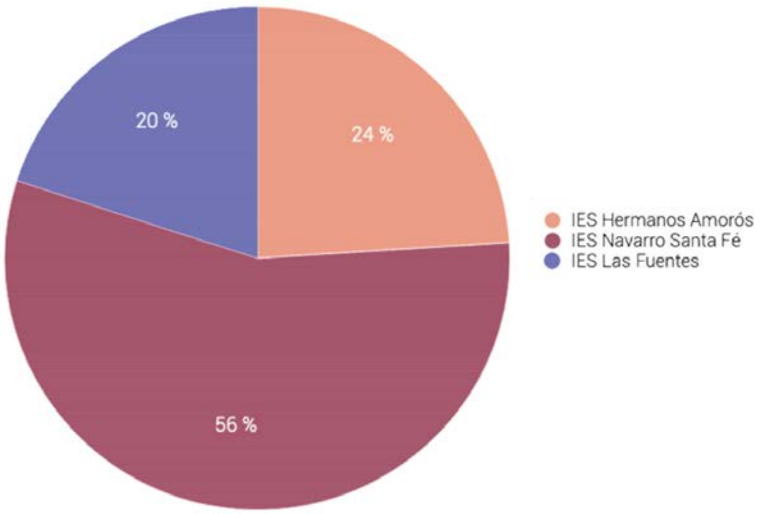
Source: Prepared by the authors based on data provided by the Villena Municipal Team for School Absenteeism. 2022

If, as has been pointed out throughout this report, early school leaving is preceded by indicators such as absenteeism during the compulsory educational stages, with greater relevance in the stages referring to Compulsory Secondary Education, in the case of the municipality of Villena and as a result of the data provided, it can be indicated that the "disengagement" factors that are going to affect the problem of early school leaving in later educational stages begin prematurely and are concentrated in a population profile with high levels of risk in later stages of education, it can be indicated that the "disengagement" factors that will affect the problem of early school leaving in later educational stages begin prematurely and are concentrated in a population profile with high levels of risk linked to the socio-economic, urban and family vulnerability that characterises the neighbourhood where the aforementioned primary education centres are located. The strong relationship between socio-economic disadvantages and difficulties in accessing secondary education, and above all, as pointed out in various studies (Eurofound, 2012), the population living in processes of social exclusion, are going to be affected by a greater possibility of dropping out of school.

In order to continue looking into the problem in more depth, it is interesting to look at the absenteeism data now referring to the Compulsory Secondary Education Centres. As has been pointed out above, in the municipality of Villena there are three Compulsory Secondary Education Centres, although there are also some Concerted Education Centres which offer the ESO cycles, but as they do not offer important or high absenteeism data, this does not affect the result of the analysis.

CHART 11.

Cases of truancy by Compulsory Secondary Education Centre, Academic year 2021-2022 (Totals).



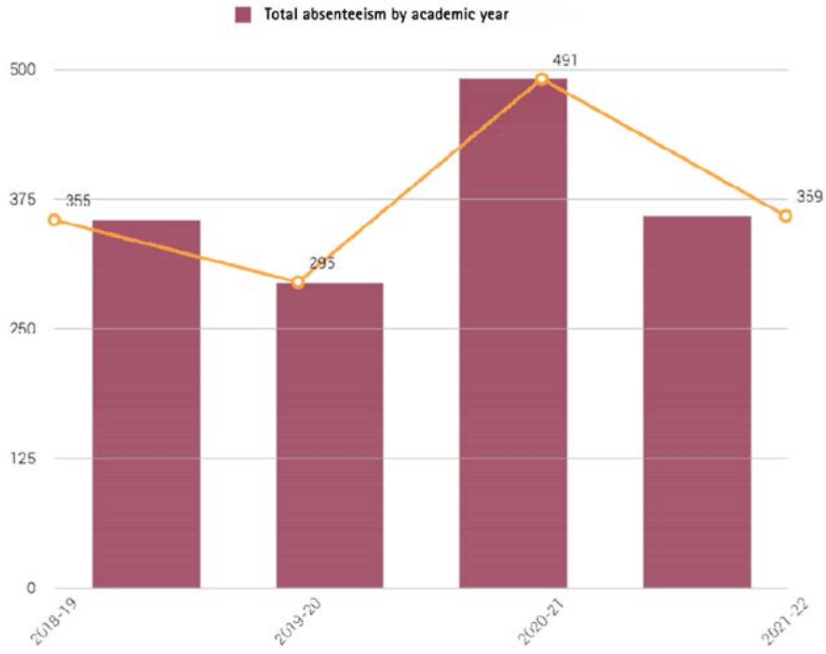
Source: Prepared by the authors based on data provided by the Villena Municipal Team for School Absenteeism. 2022

Of the three secondary schools, and as has been pointed out by the technician of the Municipal Absenteeism Team, there is only one secondary school, IES Navarro Santa Fé, which takes in pupils from the two primary schools with high levels of truancy, CEIP Santa Teresa and CEIP RupertoChapí. As can be seen in *Graph 11: Cases of Truancy in Secondary Schools, once again the* population with high levels of vulnerability and social fragility is once again concentrated in a single educational centre.

From the total number of existing educational centres in the municipality of Villena and with the data obtained on school absenteeism for the 2021-2022 academic year, we can see a transfer of high levels of absenteeism coming from primary education, which are also concentrated in a specific population profile, characterised by high levels of social vulnerability, and that once we reach compulsory secondary education the same situation is repeated, where in the case of Villena, concentrating the problem once again, this time, for a single secondary school.

CHART 12.

Evolution of truancy cases for the total number of schools and for each academic year 2018-2022 (Totals).



Source: Prepared by the authors based on data provided by the Villena Municipal Team for School Absenteeism. 2022

Along with these data, it is interesting to know the trend in absenteeism in recent years, especially from 2018 to 2022, to also know to some extent how COVID-19 and the subsequent period of confinement have affected cases of absenteeism in schools. In this regard, the Municipal Absenteeism Team pointed out that during the 2020-2021 academic year, the trend in the municipality increased considerably, especially during the months following the confinement and with the restrictive measures incorporated in the classrooms. There was a higher incidence of absenteeism among those students who already had a history of absence from school. As can be seen in *Graph 12: Evolution of cases of absenteeism for all schools*, there was an increase during the period coinciding with the pandemic and subsequent confinement, although the data are aggregated for all schools without distinction between primary and secondary, the technical team did note that this increase occurred in the same schools where there had been a higher incidence of absenteeism.

A reality is emerging in the municipality of Villena where truancy is a problem that has a certain gravity due to the fact that, on the one hand, it starts at the primary school stage and on the other hand, it is concentrated in two primary schools which in turn bring together high levels of social vulnerability. Furthermore, although when moving on to the Secondary Education stage, the cases of absenteeism decrease, in general terms there is a continuum where the problem, far from being broken, is maintained until the first stage of Secondary Education and is again concentrated in one of the three Compulsory Secondary Education centres in the town.

Data on truancy in the IES of the municipality of Villena are presented below, especially those referring to the last academic year 2021-2022, since, as has been pointed out above, at local level, cases of truancy have not decreased but have been maintained and increased in the year 2020. It is now interesting to know the stage of ESO in which there is a greater number of cases of absenteeism and this has a negative impact on the number of pupils who finally pass ESO. As we have been able to conclude throughout the report, it is in the transition from the second stage of Compulsory Secondary Education to post-compulsory education when there is a slight drop in enrolment and, above all, there is a percentage of Secondary students who do not pass the second stage of ESO and end up not graduating, this being an indicator of school failure and thus increasing the risk of early school dropout.

As there is a lack of data at local level to facilitate a complete reading of this problem, the data available must be observed with a certain degree of caution, avoiding establishing spurious causal relationships between the indicators of absenteeism, school failure and early school leaving. On the other hand, and with the support of the literature reviewed, the exploration of data at state and regional level and the qualitative information obtained through the meeting with the absenteeism team, it is possible to establish a general overview that helps to understand the problem on a local scale and that ultimately establishes the situation in the municipality of Villena and to understand, with the data already analysed, that part of the solution lies in tackling the high rates of absenteeism from the first stages of compulsory education from an integral perspective.

In *Graph 13. Cases of absenteeism by Secondary School and educational stage*, we can observe a higher incidence of cases of absenteeism in the 1st cycle of ESO, with a total of 13.74% of cases, to gradually decrease until the 4th cycle of ESO where cases are reduced to a total of 2.89%. As can be seen, it is IES Navarro Santa Fé which concentrates the highest number of cases, with 19.2% of the total number of cases, which is 12 p.p. above and in comparison to the cases that have occurred in the other two centres and for the same school year.

This continuous relationship can be observed between the dynamics followed in the primary schools - in the two schools with the highest number of absentees - and then maintained at least until the first year of ESO, for IES Navarro Santa Fé, which, as mentioned above, is the school which mainly takes in students from the primary schools with the highest number of cases. The subsequent drop may be due to various causes that must be taken into account, but among them we can find school failure, defined as the failure to pass the stages of compulsory secondary education and subsequent dropout.

As mentioned above, there is a lack of data at local level on the school failure indicator, i.e. not having passed Compulsory Secondary Education and not graduating. Even so, the data cited above in *Graph 13* does indicate that the problem of absenteeism, which is related to later school failure, is a problem that is concentrated at an early age at the local level and that prevention at an early age is fundamental to establish possible solutions to early school leaving.

CONCLUSIONS AND RECOMMENDATIONS.

- In view of the analysis carried out, it can be seen that in the case of Villena, there is a direct relationship between socio-economic vulnerability and the risk of early school leaving, with the socio-spatial segregation of educational centres being one of the factors that will exacerbate the problems linked to the process of school failure. The vulnerable profile of the young population that is absent from school, the problem of school failure is associated with socio-vulnerable problems.
- Possible concentration of the problem of early school leaving associated with the profiles of the young absentee population.
- Strong imbalances between schools with regard to the profile of people with drop-out risk factors, as well as some continuity of imbalances in the transition from primary to secondary education.
- The tendency of the municipality in the risk factor of school absenteeism, is of a progressive increase, due to on the one hand the follow-up that is being given to the cases since 2018, and on the other hand the impact that the COVID-19 pandemic and later the confinement has had on the young student population increasing the probability of absenteeism from classes.
- The lack of data on the total number of people who have passed Compulsory Secondary Education in the school where the highest number of absentees is concentrated means that we do not have direct information at local level on the repercussions that absenteeism, together with other risk factors, has on early school drop-out.
- On the other hand, data on the profile of the absentee population is known. This is a population profile with strong socio-economic and urban vulnerabilities, which already offers some knowledge about the problem at local level. This knowledge can be used by educational institutions to design a drop-out reduction strategy aimed at the population with the defined risk profile, as well as to establish an integrated early drop-out reduction strategy, taking into account educational, social and territorial factors.
- It would be interesting if the proposed strategy or solution could be designed in a cross-cutting manner, taking into account primary education cycles, which, as we have seen, is where routines of "disengagement" from school begin to be established.
- Following on from the previous recommendation, the strategies should also involve the various teams at municipal level dealing with the problem of early school leaving and have greater coordination in order to detect cases early and establish solutions.

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3.3. Croatia

Young people who do not successfully complete their education and who do not continue their education after the interruption of primary or secondary education and who do not enroll in any form of possible continuation of education are young people who leave education early.

When it comes to young people who attended and dropped out of high school before completing the planned three- or four-year program, then we are talking about the interruption of the education of young people without obtaining a certificate and without an acquired professional qualification, that is, about young people who dropped out of the system of regular education. This fact, on an individual level, gives these young people poor chances to compete on the labour market, and on a broader social level, it represents a specific social problem primarily due to the difficulties of their permanent conditions. The experience of unemployment among these young people predicts leads to unstable employability in the later years of their lives as well as worse socioeconomic status, and they often face an increased risk of social exclusion, poverty, and health problems.

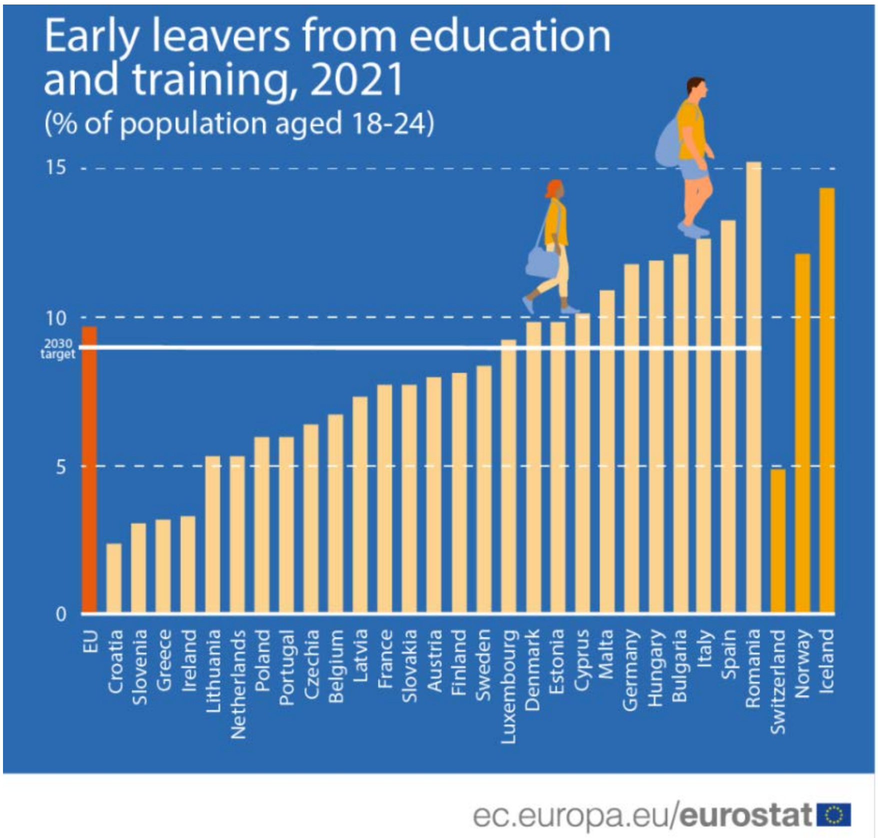
Therefore, if young people remain unemployed until the age of 24, after not completing high school education, they enter the so-called NEET population (eng. not in employment, education or training) and represent a particularly vulnerable group, because they are exposed to the risks of permanent unemployment, poverty, social exclusion, reduced motivation to start a family. Women are more exposed to these due to their larger share in that population risks. Eurostat data for 2022 show an average of 13% of the NEET population. The methodology of data collection on this population is a special topic that has been critically elaborated several times for the Croatian context, but perhaps it is worth drawing attention to the fact that the registration of this population is mainly carried out by employment offices, where only 57% of this population in the EU is registered with institutes that perform this activity.

On a personal level, the experience of NEET status can be reflected in a young person's dissatisfaction with life, mental health, feeling of lower value and status in society, and sometimes encourage non-constructive strategies or ways of life, entering the world of addiction and crime, making the person less productive and socially inclusive, which in the long run reduces the total human and social capital at the societal level. Based on the above, it can be said that the NEET population belongs to the group of vulnerable young people. The vulnerability of this population is most often manifested in the fact that it does not have sufficient socio-cultural capital to help it avoid the pitfalls and unfavourable consequences of NEET status. In order to ensure the conditions for the inclusion of these young people in educational programs for active participation in the labour market, the state must ensure the implementation of various measures and reforms that represent specific additional education programs at the national level, which the European Commission clearly prescribes for each member of the Union in its operational program for effective human resources for the period 2014-2020. (Operational plan - effective human resources 2014-2020).

Smart planning of social policies that includes, among other things, social investment in the development of the human capital of society, which is necessary from an early age, during the period of education and beyond, in order to prepare them to face risks, instead of repairing the consequences of personal and social crises that have affected them. Including the NEET population in the labour market and reducing the early school leaving rate of young people is one of the main goals of the Europe 2020 strategy which includes intervention measures and measures aimed at returning young people to some form of education and preparation for more permanent employment (European Commission, 2013).

A Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (known as EEA 2030) was agreed by the Council in February 2021. It outlines five strategic priorities for the period 2021-2030: improving quality, equity, inclusion and success for all in education and training; making lifelong learning and mobility a reality for all; enhancing competences and motivation in the education profession; reinforcing European higher education; and supporting the green and digital transitions in and through education and training. For monitoring progress, seven EU-level targets, i.e. reference levels of European average performance, have been defined, including that the share of early leavers from education and training should be less than 9 %, by 2030.

In 2021, an average of 9.7 % of young people aged 18-24 in the EU were early leavers from education and training. Across EU Member States, the proportion of early leavers in 2021 ranged from 2.4 % in Croatia to 15.3 % in Romania. The countries with the lowest proportion of early leavers were Croatia, Slovenia, Greece and Ireland where the share was below 5 % (the same was noted for Switzerland). The highest shares were found in Romania (15.3 %), followed by Spain and Italy with around 13 %. There were thus large differences between the EU Member States where 16 countries have already reached the EU-level target for 2030, i.e. their share of early leavers from education and training is already less than 9 %. Switzerland and Serbia also reached the level less than 9 %.



Nowadays, high school education is becoming one of the largest demands that the society places on the individual. Modern, market-competitive societies require flexibility in the labour market and quick adaptation to new technologies and the trend of lifelong education. In parallel with such trends in developed countries, people who leave school before finishing high school, become a particularly vulnerable group. Young people without a high school diploma face many difficulties - from economic ones, such as unemployment, temporary employment, low incomes, and the impossibility of business advancement, to social ones (the need for social assistance, antisocial behaviour, social exclusion), but also personal (low self-esteem, family problems). Some of the most serious problems facing Croatian society today are precisely related to the weak educational structure of the population, which is still dominated by people with secondary and elementary school education.

According to the data of the Central Bureau of Statistics, Croatia has approximately fifty thousand students in per generation, approximately 12 percent of them never finish high school. This is why, in a year, a large number of low-skilled people with only completed primary school or even without it appear in the labour market, which is a serious obstacle in achieving the set economic goals of the country and achieving greater competitiveness. At the same time this is a relatively large number of young people who, often due to their modest education, have limited employment opportunities and have already been exposed to risks of poverty and social exclusion at a young age.

To get an insight into the problems that lead to early school dropout in Croatia, a large-scale qualitative and quantitative research was conducted, by means of focus groups and surveys, on representative samples of high school students, their teachers and parents, and young people who dropped out of school by Institute of Social Sciences dr. Ivo Pilar.

The data revealed that most frequent reasons of school dropout include low academic achievement and lack of motivation, discipline issues, and financial problems. Respondents could choose several answers, so it can be concluded that they leave school due to a combination of several elements. Other reasons, like early employment and inability to balance school and work, or specific ones like illness, pregnancy, or marriage were cited less frequently. Regression analysis additionally confirmed such results, indicating low school grades, grade retention, low socioeconomic status, and low level of mother’s education to be the strongest predictors of early school dropout. Cluster analysis identified three types of school dropouts which differed regarding their school achievement, family sociodemographic characteristics, and reasons for leaving school.

The adolescent's life can be filled with various aggravating circumstances that threaten and can expose them to risks of vulnerability. The term "social vulnerability" was coined by the Belgian researchers van Kerckvoorde, Vetterburg and Walgrave, which describes individuals "...who are in contact with social institutions and are more exposed to control and sanctions than benefits. At-risk adolescents are those who are exposed to the negative effects of factors in their life world, to which the term social exclusion can sometimes be associated. Despite the vagueness of the term, it is used to denote the unfavourable, marginalized position of certain social groups, including vulnerable youth. In addition, we also use the term "youth in a society of risk and insecurity". A pan-European survey (Eurofund, 2012), conducted by an international group of experts, showed that certain social categories of young people belong to the most vulnerable group of NEETs. These are less educated youth who are three times more likely than other groups to belong to NEET, followed by youth with an immigrant background who have a 70% probability, sick and disabled youth who have a 40% probability of joining NEET and the poor young people who are 40% more likely and children of divorced parents who are 30% more likely to belong to this group. The vulnerability of the NEET population is manifested on several levels, because they are more likely to be unemployed, become underage parents, be in conflict with the law, have experience of drug and alcohol abuse, be in poorer health and have bad family relationships, which can generate these problems into the next generation. The adolescent's world is the everyday world in which he lives. In this world, one navigates and develops life strategies based on personal experience and experience with significant and general others. The term "strategy of behaviour or (re)living" refers to all those forms, ways or patterns of behaviour, action, communication that a certain person has developed in his life so far. The person develops life strategies based on his/her ideas about reality.

Therefore, the main guideline in the professional work with vulnerable youth is to understand what strategies for dealing with problems the vulnerable adolescent uses,~~-~~which he developed based on the interpretation of his own experiences. Research has shown that, considering the above, we can distinguish between three types of adolescents:

1. Adolescents who enter the "philistine" profile often do well in a more restrictive school environment and they easily accept school rules. In addition, the term philistine can include young people who respond to life situations mostly without conflict and are "quiet" people who conform to reality and are aware of the loss of a global social perspective. Among the young people who leave education, there will likely be fewer of those from the philistine profile, because young people will drop out of school mostly because of a subjective feeling of the excessive complexity of the educational program, and not because of conflicts with teachers and the like.
2. The second type is so colled “bohemian”, the personal or active "I" is in the foreground. The dialogue between personal and social thinking is unclear and chaotic. A person does not know the rules, but even if he knows them, he does not respect them and does not follow them. Some teachers could define adolescents who are close to this analytical category as artistic persons, describing them as follows: “These young people are bored in lectures, they are more versatile, I would say that they are artistic souls. They are artistic types for whom the school generally cannot provide enough desired activities.”
3. The analytical concept of “creative individuals” includes young people who establish a balance between personal and social self, thinking. Dialogue is therefore creative. The person knows the rules but changes them if they are inappropriate or ineffective. The term creative individual could be connected to those characteristic reactions of young people to different life situations in contemporary society, defined as the responses of young subcultures, and which represent a form of unique or even "anti-structural" processing of reality. These adolescents can ironize reality and turn it upside.

The bohemian type of strategy represents a temporary exit from everyday life into an illusory community. Leaving the school system and entering another "illusory community" on the street or dropping out of school becomes a way out for them. Adolescents who could be considered creative individuals can also be found among them, especially if there is a conflict between them and the rigorous, philistine aspects of a particular school environment or of certain teachers or their leadership. So, the bohemian type and creative individual can be in danger of school leaving so we have to recognize them, to offer a different method in teaching and to give them support in order to stay in school.

To get to know the resources and risks of the environment in which a young person lives, it is important to evaluate possible favourable and unfavourable factors of formal and informal sources of social networks. These factors are most often analysed in the context of interactions between family, school, communities, and individual institutions. Macro-level analysis refers to the existence, quality, and the availability of different resources on social and national level. This group of resources includes educational opportunities, different educational programs, national social protection programs and other similar resources through which, among other things, a formal social network of institutions is formed which can provide forms of protection for young people from social exclusion.

In professional helping work with young people, creative methods are the basis for a successful outcome, primarily because, in their growing up, we want to encourage the expression of personal needs and interests and the development of the ability to cope with certain situations. Professional literature emphasizes that professional work with vulnerable young people assumes that creativity in the broadest sense is understood as a skill and ability to manage in everyday life. Margaret Boden distinguishes between personal or psychological and historical or social creativity, whereby psychological creativity is that created by a certain person, and historical or social creativity is that idea that no one has ever had before (Boden, 2004).

In everyday life, personal creativity is often neglected because more attention is paid to aspects of social creativity, since we are mostly fascinated by special, great (artistic or scientific) achievements. From the aspect of helping work with young people, it is important to direct the contents and methods of work to encourage the development of their capacities for personal creativity.

From the perspective of a helper, whether it is a social worker, a counselor or a teacher who is involved in helping work with vulnerable young people in various social risks such as dropping out of the education system, it can be said that they are losing touch with their own creativity. In these situations, their capacities for effective, self-protective and creative coping with everyday challenges and pressures are reduced, and then they often lack internal strength, but also external resources to create favourable outcomes problem situations, and therefore, they increasingly lose control over their own lives.

To restore young people's faith in their inner strength and creativity aimed at overcoming a problematic situation, experts, especially those who work in schools, apply the principles of social cultural work, i.e., social or advisory work starting from needs, wishes and expectations of young people and from their experience of their own world so that they regain control of their lives and integrate into society. At the same time, experts in the school, including social workers who implement various preventive programs in schools, try to intervene in the structuring of free time of particularly vulnerable young people, encouraging the quality of the content of activities and the development of young people's potential to deal with unfavourable factors in their closer social network, from family to peers. The purpose of these activities and such an approach is to mitigate the exposure of these young people to the risk of social inequality, discrimination, marginalization, poverty and the consequences of damaged and inappropriate interpersonal relationships in their micro-level of the ecological system.

Due to the complex nature of early school leaving, all other relevant stakeholders must approach and solve this problem together. To reduce early school leaving and promote the educational success of all students, a "comprehensive approach to schooling" is needed. All education stakeholders (principals, teaching and non-teaching staff, students, parents, and families), as well as external educational and non-educational stakeholders, have an important role in overcoming the unfavourable educational situation and preventing school dropouts. All stakeholders are responsible for engaging in cohesive, collective, and collaborative action based on multi-disciplinary and differentiation. From such a sustainable perspective, school is a multidimensional and interactive system that can learn and change. A coordinated approach to all dimensions of school life is needed to encourage change; this implies that in the process of teaching and learning, as well as in the everyday life of the school, the needs of everyone (students, staff, and the wider community) are considered.

Croatian success in preventing ESL

The research carried out in 2011 listed the causes of dropping out of school among the secondary school population. There is no recent systematic research that would show what comparative advantages, that is, the strategies that the Republic of Croatia undertakes to prevent early school leaving there are. The reason for this is probably that for years Croatia has been at the bottom of the European list in the number of students who drop out of school.

The results of Croatia's success in this segment can be discovered by analysing the factors that have been detected as the primary causes of dropping out of school: discipline problems, social problems in the family, poor academic performance, boredom, and absenteeism. Research has shown that it is usually a combination of factors that influence school leaving, and it seems that in the Croatian system we are equally successful in fighting all the mentioned factors.

a) Discipline

Students who have behavioural difficulties already from elementary school (which is mandatory by law in Croatia) are monitored in several ways. In Croatia, there is a system of pedagogical measures to encourage and prevent. Preventive measures, which are aimed at students with behaviour problems in order to direct them towards acceptable behaviour, and monitoring system (if socialization fails completely) which pays more attention to their educational path with appropriate support from school pedagogues, social pedagogues or centres for social care, put them on the right track. Pedagogical prevention measures in secondary school include: warning, reprimand, warning before expulsion and expulsion from secondary school. It is interesting that in practice expulsion from secondary school is very rare, almost non-existent. After all measures have been exhausted and the student has been expelled from secondary school, the student has the right to file an appeal, which is regularly done, and as a rule returns to the education system. It seems that with this strategy of "keeping students in school at all costs", the working environment, that is, the school of the student who creates problems, often suffers, but in the end, it still keeps the problematic student in school and enables the completion of education.

b) Absences

Students are absent for several reasons. Social reasons are often cited, which include poverty (the student has to work, there is no money for transportation, books, etc.), lack of motivation and boredom, poor academic performance, and non-acceptance of the environment. Absenteeism is rarely the only symptom that something is wrong or the reason for early school leaving. In the Croatian system, absences are regularly monitored via e-register (online monitoring platform) and parents are informed in a timely manner about students not attending classes. If the student unjustifiably missed more than 0.5% of the teaching hours out of the total number of hours in which he should have been included during the academic year, a preventive measure (warning) follows. A pedagogic measure of reprimand is imposed in the event that the student has unjustifiably missed more than 1% of the teaching hours out of the total number of hours in which he should have been included during the academic year. Pedagogical warning before expulsion for a high school student is issued in the event that the student has unjustifiably missed more than 1.5% of the teaching hours out of the total number of hours in which he should have been included during the academic year. Schools react by calling parents to a meeting already after a few unexcused hours, and after higher number of unexcused hours, the pedagogical service and the centre for social work are involved in order to determine the cause of the absences.

c) Social reasons

There are a whole range of external causes that can affect a student's dropping out of school. The system tries to recognize and respond to factors that could lead to dropping out of school, such as poverty, domestic violence or child neglect. Such cases are already noticed in primary school and, in cooperation with the centre for social work, are alleviated or solved in such a way that the child is removed from the family that is dangerous to the child's health and life. If it is a case of poverty, the family is helped to, at least, fulfil the obligations arising from the requirements of education. The student is provided with free textbooks and accessories, a free meal at school, paid transportation to school, and the like. Students who are separated from their families are placed with foster parents for temporary care or in homes for neglected children. There they get guardians who, among other things, take care of their success in school. It is very difficult to completely influence social reasons and problems in the family, but the school and the whole system do what they can to help the student who is in trouble.

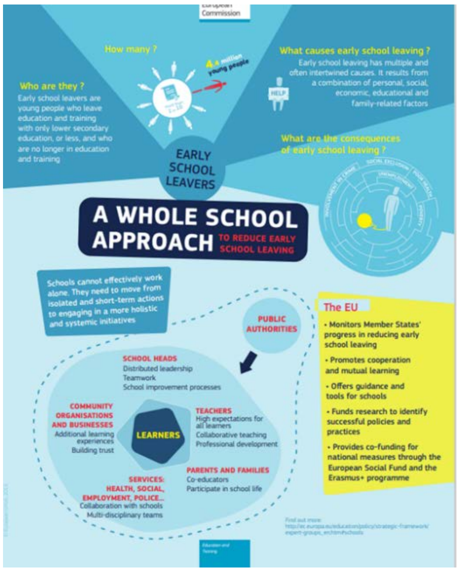
d) Poor academic performance and boredom

We will deal with these two factors together because they are often correlated. Poor academic performance is achieved for a variety of reasons; weaker abilities, lack of motivation, not finding one's way in the system and the like. In Croatia, since the introduction of the curricular reform, educational goals have been focused on the achievement of learning outcomes, and no longer on the acquisition of content. With this, we gained concreteness, focus on the development of the entire set of skills, and it should be clearer to both students and teachers where teaching leads and what they should know and/or be able to do after the teaching process. Teaching is mainly interactive, process-oriented and based on active learning methods. Pupils study at school, and no longer at home (after regular classes). In addition, in Croatia, great attention is paid to the special and individual needs of students, if there is such need. Teachers create special curricula for children with learning disabilities. In the event that a student has difficulties in certain segments of teaching or content, teachers in that case individualize teaching, i.e. adapt methods to the student so that we all get better results together and so that teaching is successful. In addition to students with adaptation or individualization of content, for other students, who make up the majority, the teaching is made life-related and interesting by using different methods and forms of teaching: project teaching, flipped classroom method, use of digital tools to contribute to interactivity. The method of work that is especially encouraged is working in a group, which enables students to be inclusive, peer teaching and the development of social skills. As previously mentioned about the differences in students, students who belong to "creatives" have a harder time accepting a school where teaching is conducted "ex cathedra" where students have the role of audience, and the teacher is the main actor. For such students, teaching focused on the student, on creative expression and cooperation proves to be particularly good.

In conclusion, the Croatian example may not be universally applicable, but given that for ten years we have been at the bottom of the ranking according to European research, that is, we have the lowest percentage of students who leave school early, it might not be a bad idea to think about these approaches and strategies.

It seems that we are already on the trail of what the European Commission sets as its goal until 2025. Here is how the EC defined the problem and proposed solutions. Leaving school early is associated with unemployment, social exclusion, poverty and health problems. There are many reasons why some young people give up on education and training prematurely: personal or family problems, learning difficulties or a difficult socioeconomic situation. The organization of the educational system, the atmosphere in the school and the relationship between teachers and students are also important factors.

Since the reasons why young people do not complete secondary education are often complex and interrelated, policies to reduce early school leaving must cover a range of issues and include education and social policy, youth work and health-related aspects. Some of the challenges are outlined in an infographic produced by the Commission.



EU level - What has been done so far?

• EU Education Ministers adopted a Council Recommendation on policies to reduce early school leaving as a framework for coherent and comprehensive policies based on reliable data. They agreed to cooperate and exchange the best examples from practice and knowledge about effective ways to solve the problem of early school leaving.

• The working group on early school leaving considered examples of good practice in Europe and shared experiences in reducing the rate of early school leaving. In the final report, they presented 12 key messages addressed to policy makers and practical tools in the form of a list of comprehensive policies and annexes with best practice examples in several EU member states.

• The commission organized a conference on policies to reduce early school leaving. A year later, the progress in their implementation was reviewed in eight EU member states.

• The School Policy Working Group has developed policy messages outlining key conditions for implementing a comprehensive approach to tackling early school leaving, as well as a European Toolkit for Schools.

• The Council also adopted Conclusions on reducing early school leaving and promoting success in school.

The European Commission has published an assessment of the effectiveness of policies and practices developed at EU and national level since 2011 to address the problem of early school leaving in 37 European countries.

The study shows that the effect of EU policy instruments is mostly positive in all the countries covered. From 2011 to 2019, the average early school leaving rate in Europe decreased from 13.4% to 10.2%.

However, there are still considerable differences between countries and in their demographic structure, with people of migrant origin, young men and people living in rural areas more likely to leave school early.

Therefore, further measures are needed to stop this complex growing trend. The study compares examples of good practice at the national level and makes a number of recommendations for future policy-making in this area.

In the Communication on the establishment of the European education area by 2025, the Commission announced a new initiative - Pathways to school success. This initiative will help all students achieve a basic level of mastery of basic skills.

The initiative will have three goals:

• give all young people the opportunity to master basic skills at a certain level

• reduce the number of young people who leave education before finishing at least secondary school

• take care of the well-being of students at school.

https://hrcak.srce.hr/clanak/90523

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Early_leavers_from_education_and_training#Early_leavers_from_education_and_training_.E2.80.93_today_and_a_historical_comparison

https://education.ec.europa.eu/hr/education-levels/school-education/early-school-leaving

3.4. GERMANY

Before examining the data and statistics on the rates of students leaving school without qualifications, it is necessary to define the terms involved. Finally, the following explanations will also provide an up-to-date overview of the situation in schools with regard to early school leavers and school dropouts in Germany, but especially in Bavaria. Furthermore, a brief analysis of the possible causes of early school leaving or dropping out is essential in order to ultimately turn to possible strategies of either avoiding early school leaving or dropping out or otherwise re-integrating these students.

1.Definition and differentiation of early school leavers and school dropouts

First, the concept of early school leavers should be defined, followed by the definition of school dropouts. According to the Bavarian Law on Education and Teaching (BayEUG), compulsory schooling in Bavaria lasts twelve years, unless otherwise specified. These twelve years of compulsory schooling are in turn divided into nine years of full-time compulsory schooling and a further three years of compulsory vocational schooling. For children who live in Germany, compulsory full-time schooling usually begins at the age of six and ideally ends at the age of fourteen. This is followed by three years of compulsory vocational school, provided there is no exemption from attending vocational school.

(1) Those who meet the age requirements and have their habitual residence in Bavaria or are in vocational training or employment are subject to compulsory school attendance (school age). Compulsory schooling within the meaning of sentence 1 is also who […]

(2) Compulsory schooling lasts twelve years, unless this law provides otherwise.

(3) Compulsory schooling is divided into full-time compulsory schooling and compulsory vocational schooling.[1]

Early school leaving

Premature school leaving is when a student has left a course of education after completing compulsory full-time schooling, but without switching to another general education course and without having at least obtained the lower secondary school leaving certificate[2]. This also includes special needs students who leave the school with a specific qualification from the special needs school (in the specialization areas of learning or intellectual development).

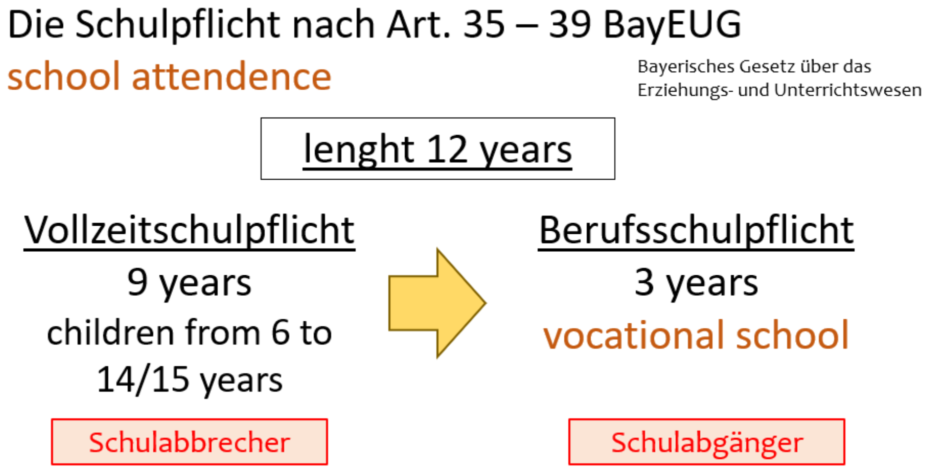
School dropouts

School dropouts, on the other hand, is the term for students who left school before completing compulsory full-time schooling and without a school-leaving certificate. Both terms, early school leaving and school dropouts, have in common that the pupil left school without a

1 https://www.gesetze-bayern.de/Content/Document/BayEUG-35

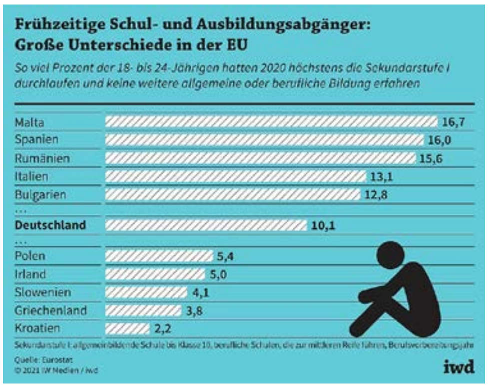
2 When it comes to the Hauptschule leaving certificate, a distinction is made between “Successful Hauptschule leaving certificate”, i.e. after successful completion of the ninth grade of Hauptschule, Realschule, Wirtschaftsschule, Gymnasium and the “Qualifying Hauptschule leaving certificate (Quali)”, i.e. after passing the exam at the end of the ninth grade of Hauptschule -/middle school. (siehe https:// www.km.bayern.de/download/2973_km_uebertrittsberatung_100301.pdf)

qualification (school qualification factor). On the other hand, the difference lies in the time at which school is left (time factor): a school dropout leaves school during or before the end of full-time compulsory education; an early school leaver leaves school after full-time compulsory education has already been completed. This version is intended to illustrate a self-created scheme again (see Appendix Graphic 1):



2. A comparison of school leaver and school dropout rates

Early school leavers in an EU comparison



A first statistic[3] shows the school-leaver rate in Germany in a European comparison.[4]

It should be noted here that early school leavers are 18-24-year-old who have completed secondary education but have not received any further education or training. In a European comparison, Germany is in the middle with a rate of 10.1 percent. Malta is the leader with 16.7 percent when it comes to early school leavers. Croatia, on the other hand, can impress with a rate of only 2.2 percent and thus has the fewest early school leavers in the EU. From a German perspective, the statistics are interesting because one could analyze the difficulties that EU countries such as Malta or Spain have and which strategies result from this to remedy this situation. One could learn from these "mistakes" and possibly transfer the gained experience to

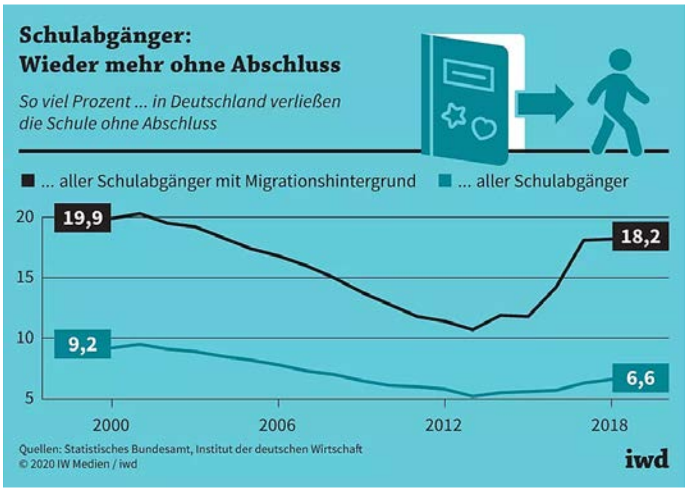
[3] https://www.iwd.de/artikel/steigt-wegen-corona-die-zahl-der-schulabbrecher-522007/ (22.10.2022)

[4] The EU countries are meant here.

one's own school system. On the other hand, it would be advantageous to adopt successful strategies from EU countries such as Croatia or Greece and apply them to your own school system in order to improve it, especially with regard to the rate of early school leavers.

Early school leavers and school dropouts in Germany

Since the so-called PISA shock around 2000 and the resulting education reform, Germany managed to gradually reduce the school-leaver rate from 9.2 percent (before 2000) to a percentage of almost 5 percent by 2013, as another statistic[5] shows (Graphics 3).



Here, too, a consideration of the resources used and the strategies applied that led to this success would be interesting and valuable, but cannot be undertaken here as the focus of this explanation is to be on the causes of early school leaving and school dropouts. This statistic also shows that the school-leaving rate gradually increased again around 2013, returning to 6.6 percent in 2018. The statistics also show that of the 9.2 percent school leavers, almost 20 percent were school leavers with a migration background, and at the time it was also possible to gradually reduce this number. However, after 2012 the number of school leavers with a migration background increased disproportionately compared to the overall rate and rose again to 18.2 percent in 2018. A press release from the Bertelsmann Foundation summarizes this development as follows:[6]

"The risk of dropping out of school for foreign students, like for German students, had fallen for a long time. Since 2011, however, the developments have decoupled: while the proportion of German students without a degree has continued to decrease, that of foreigners has risen slightly to 12.9 percent."

In a press release in the *Süddeutsche Zeitung* of December 12, 2019, the Caritas Association drew attention to the increasing number of school dropouts and cited immigration since 2015 as an explanation.[7] The conclusion is obvious - at least in correlation to the statistics just mentioned and the article - that the increasing number of people with a migration background in Germany could be related to the increasing number of school leavers and school dropouts in Germany as a whole. The results of the Education Monitor from 2019 even show that in

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5 https://www.iwd.de/artikel/zahl-der-schulabgaenger-ohne-abschluss-steigt-wieder-480556/ (22.10.22)

6 https://www.bertelsmann-stiftung.de/de/presse/pressemitteilungen/pressemitteilung/pid/bessere-chancen-fuer-schueler-aber-unterschiede-zwischen-bundeslaendern-wachsen

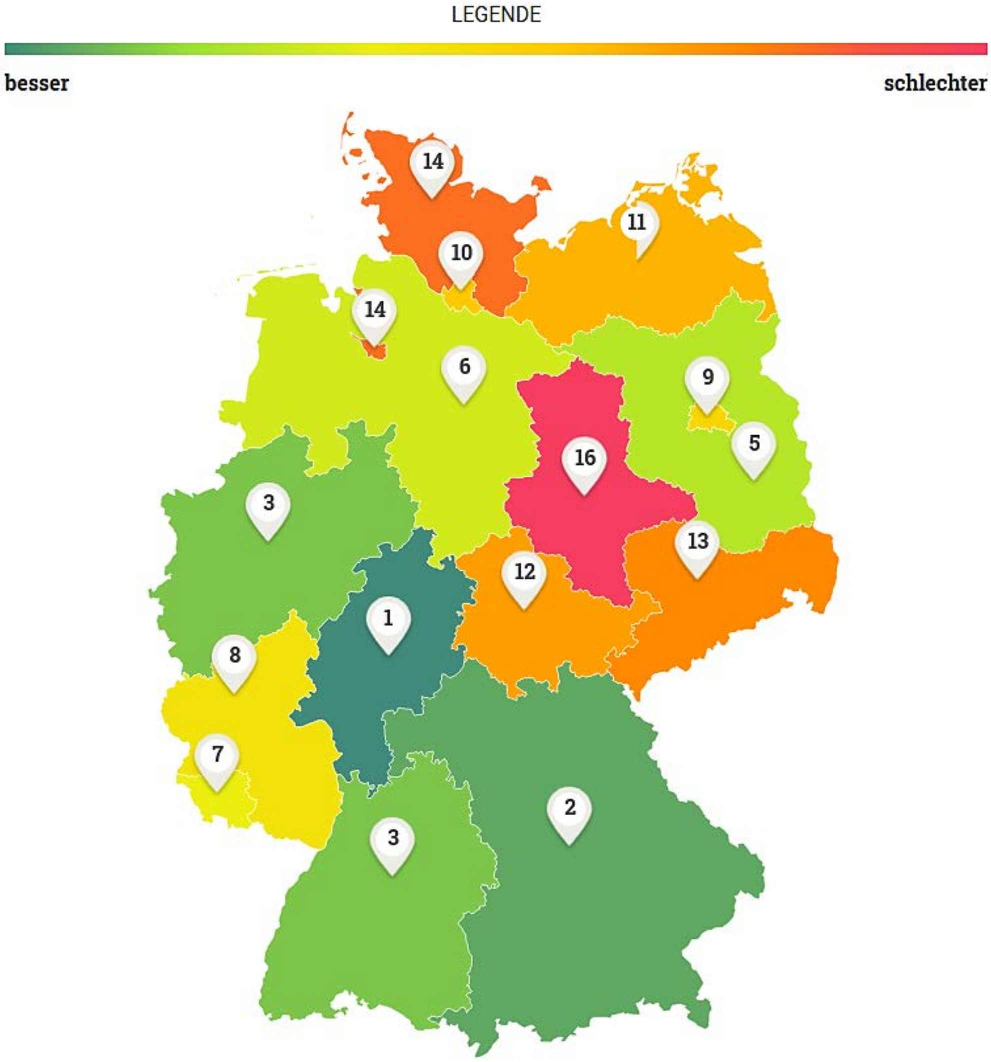
7 https://www.sueddeutsche.de/bildung/schulabbrecher-ausbildungsplaetze-dgb-1.4720806 (17.10.2022)

Germany the school dropout rate has risen from 5.7 to 6.3 percent within one year - among foreigners even from 14.2 to 18.1 percent.[8] This point becomes relevant in relation to further data and figures elsewhere in this chapter. This aspect is also taken up again in the analysis of the causes of early school leavers and school dropouts.

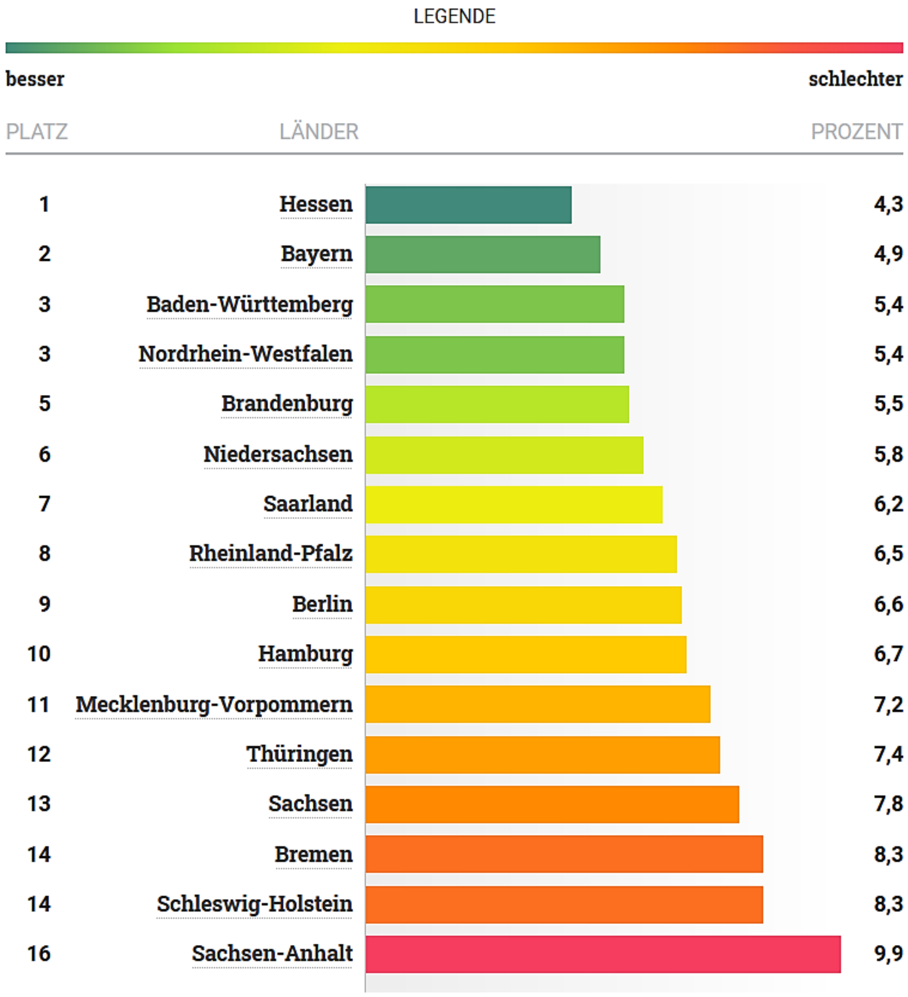
School dropouts in Bavaria

Before looking at the figures for early school leavers with regard to the state of Bavaria, an overview should first be created by listing the figures for the entire Federal Republic. The map from the INSM Education Monitor 2022 (Graphic 4) shows the 16 federal states of the Federal Republic of Germany in different colors, with a graduation from the color green (= better) to the color orange (= medium) to the color red (= bad).

In the Germany-wide ranking, the federal state of Bavaria takes second place with a good school dropout rate, i.e. one of the federal states with the fewest school dropouts. As an extension, the statistics associated with this map (Graphic 5) also list the percentage of school dropouts.



8 https://www.zeit.de/gesellschaft/schule/2019-08/bildungsmonitor-2019-bildungsausgaben-jugendliche-schulabbrecher-insm?utm_referrer=https%3A%2F%2Fwww.google.com%2F (17.10.2022)



As just mentioned, Bavaria is in second place nationwide with a school dropout rate of 4.9 percent, right behind Hesse, which takes first place with a school dropout rate of 4.3 percent. For comparison, the capital Berlin is in the middle with 6.6 percent, the state of Saxony-Anhalt with 9.9 percent in last place. Due to these poor numbers, the federal state of Saxony-Anhalt commissioned a study in 2020 to examine the factors influencing school success and school dropouts.

An interesting note in this regard is that the focus of the interviews within the framework of this study is not on the individual and family characteristics of the students, but rather on the characteristics of the teaching and the school are the focus of the study. In an interview with the head of this project, Raphaela Porsch, factors such as the quality of teaching and the school climate are linked to school success. However, parental work is also emphasized as an important point for the school success of the pupils.[9] However, this point needs to be looked at from two perspectives, because parenting cannot work from just one right. This point will be taken up again at another point in this thesis. The study also shows that, as in all other federal states, school avoidance or absenteeism precedes school dropout and this is exactly where intervention is needed. This is also discussed in more detail elsewhere in this work.
The following tables from the Bavarian Education Report show the absolute numbers of school leavers and the numbers as a percentage of the population of the same age, broken down into the categories of boys, girls, German citizenship and no German citizenship (Figure 7).

9 https://deutsches-schulportal.de/schule-im-umfeld/studie-sachsen-anhalt-wie-sich-schwaenzen-und-schulabbruch-vermeiden-lassen/ (11.12.2022)

Schulabschlüsse der Abgängerinnen/Abgänger bzw. Absolventinnen/Absolventen
mit erfüllter Vollzeitschulpflicht von allgemeinbildenden Schulen und Wirtschaftsschulen nach Geschlecht und Staatsangehörigkeit (Bayern, Schuljahr 2018/19)

Angabe	Gruppe	Abgängerinnen u. Abgänger ohne Abschlusss	Abschluss der Förderschule	Erfolgreicher Abschuss der Mittelschule	Qualifizierender Abschuss der Mittelschule	Mittlerer Schulabschluss	allgemeine Hochschulreife
Schulabgängerinnen und Schulabgänger absolut	insgesamt	4.307	2.667	10.033	16.775	59.041	36.632
	Jungen	2.845	1.605	6.187	9.813	29.173	16.677
	Mädchen	1.462	1.062	3.846	6.962	29.868	19.955
	deutsche Staatsangehörigkeit	2.371	2.341	7.653	13.991	55.186	35.261
	keine deutsche Staatsangehörigkeit	1.936	326	2.380	2.784	3.855	1.371
In Prozent der gleichaltrigen Bevölkerung	insgesamt	3,6%	2,1%	8,3%	13,9%	48,4%	28,3%
	Jungen	4,6%	2,5%	10%	15,9%	46,3%	24,7%
	Mädchen	2,5%	1,7%	6,5%	11,9%	50,5%	32,3%
	deutsche Staatsangehörigkeit	2,2%	2,1%	7%	12,9%	50,1%	30,6%
	keine deutsche Staatsangehörigkeit	16,3%	2,5%	19,9%	23,4%	31,1%	8,8%

Quelle: Amtliche Schuldaten des Bayerischen Landesamtes für Statistik

ohne Schulen des zweiten Bildungswegs
In Prozent der gleichaltrigen Bevölkerung: Dabei wird für jeden einzelnen Altersjahrgang der Bevölkerung der relative Anteil der Schulabgängerinnen und Schulabgänger bestimmt. Durch Addition dieser jahrgangsspezifischen Anteile ergibt sich die Gesamtquote (Quotensummenverfahren). Stichtag für die Bevölkerungsdaten ist der 31. Dezember des Jahres, das dem jeweiligen Berichtsjahr vorausgeht, für 2019 also der 31. Dezember 2018.

aus der Tabelle des Bildungsberichts Bayern 2021

What is remarkable at this point is the value of 16.3 percent (depending on the population) of graduates without a degree who do not have German citizenship. Two observations are also striking: there are twice as many school dropouts as women and the majority of school leavers without a degree do not have German citizenship.
If you take a close look at the individual types of schools in Bavaria, this point also becomes apparent. Here it says:

The differences between gender and nationality also existed in the school year2018/19 (see table B3/a-web). Girls were more likely to acquire one middle school certificate or a high school diploma as a boy. young people without Germans Citizenship is about seven times more likely to leave school without a degree left as German teenagers. German youngsters were able to graduate from high school acquire three to four times more often than foreign ones. Since the gender-specifically differences among young people with German citizenship and apply equally without German citizenship, do young men without German citizenship compared to other groups most frequently
Feast of all no qualifications and least often the Abitur.[10]

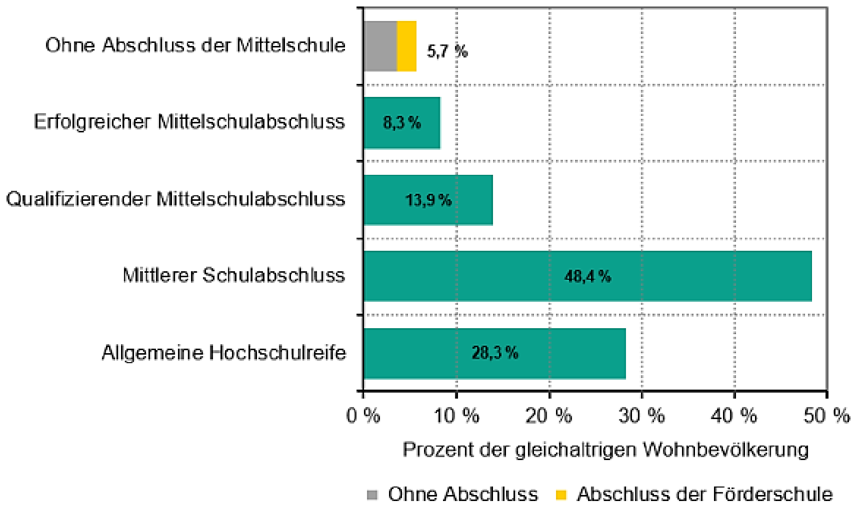
An additional look at the numbers and statistics in the education report expands this statement (Figure 6, Figure 8, Figure 9).

10 https://www.las.bayern.de/qualitaetsagentur/bildungsberichterstattung/downloads/bildungsbericht_ bayern_2021.pdf S.24

Abbildung B3/a

Schulabschlüsse an allgemeinbildenden Schulen

Abgängerinnen/Abgänger bzw. Absolventinnen/Absolventen mit erfüllter Vollzeitschulpflicht in Prozent der gleichaltrigen Wohnbevölkerung im Schuljahr 2018/19 in Bayern



Quelle: Amtliche Schuldaten des Bayerischen Landesamtes für Statistik

Gesamt: einschließlich Wirtschaftsschulen und ohne Schulen des zweiten Bildungswegs

Tabelle B3/a

Schulabschlüsse der Abgängerinnen/Abgänger bzw. Absolventinnen/Absolventen mit erfüllter Vollzeitschulpflicht an allgemeinbildenden Schulen und Wirtschaftsschulen nach Schulart (Bayern, Schuljahr 2018/19)

Schulart	Abgängerinnen und Abgänger ohne Abschluss	Abschluss der Förderschule	Erfolgreicher Abschluss der Mittelschule	Qualifizierender Abschluss der Mittelschule	Mittlerer Schulabschluss	Allgemeine Hochschulreife	Insgesamt
Mittelschule	3.346	x	7.385	15.585	14.421	-	40.73x
Förderzentrum	323	2.666	1.203	302	77	-	4.571
Wirtschaftsschule	168	-	466	635	4.803	-	6.072
Realschule	337	-	501	141	36.010	-	36.989
Gymnasium	99	-	324	59	3.363	36.281	40.126
Sonstige allgemeinbildende Schulen	34	-	154	53	367	351	959
Insgesamt	**4.307**	**2.66x**	**10.033**	**16.775**	**59.041**	**36.632**	**129.45x**

Quelle: Amtliche Schuldaten des Bayerischen Landesamtes für Statistik

Gesamt: einschließlich Nichtschülerinnen und Nichtschülern

Realschule: einschließlich der Realschulen zur sonderpädagogischen Förderung, ohne Abendrealschulen

Gymnasium: ohne Abendgymnasien und Kolleg

Sonstige allgemeinbildende Schulen: Freie Waldorfschulen, Integrierte Gesamtschulen

x: Wert wird aus Datenschutzgründen unterdrückt

Tabelle B3/a

Schulabschlüsse der Abgängerinnen/Abgänger bzw. Absolventinnen/Absolventen mit erfüllter Vollzeitschulpflicht an allgemeinbildenden Schulen und Wirtschaftsschulen nach Schulart (Bayern, Schuljahr 2015/16)

Schulart	Abgängerinnen und Abgänger ohne Abschluss	Abschluss der Förderschule	Erfolgreicher Abschluss der Mittelschule	Qualifizierender Abschluss der Mittelschule	Mittlerer Schulabschluss	Allgemeine Hochschulreife	insgesamt
Mittelschule	3.427	–	8.003	17.015	14.823	–	43.268
Förderzentrum	606	2.255	1.268	302	122	–	4.553
Wirtschaftsschule	90	–	403	631	5.377	–	6.501
Realschule	380	–	442	161	40.962	–	41.945
Gymnasium	122	–	353	67	3.665	38.248	42.455
sonstige allgemeinbildende Schulen	153	–	27	57	419	323	979
insgesamt	4.778	2.255	10.496	18.233	65.368	38.571	139.701

Quelle: Amtliche Schuldaten des Bayerischen Landesamtes für Statistik

Inklusive Nichtschülerinnen und Nichtschülern

Realschule: inklusive der Realschulen zur sonderpädagogischen Förderung, ohne Abendrealschulen

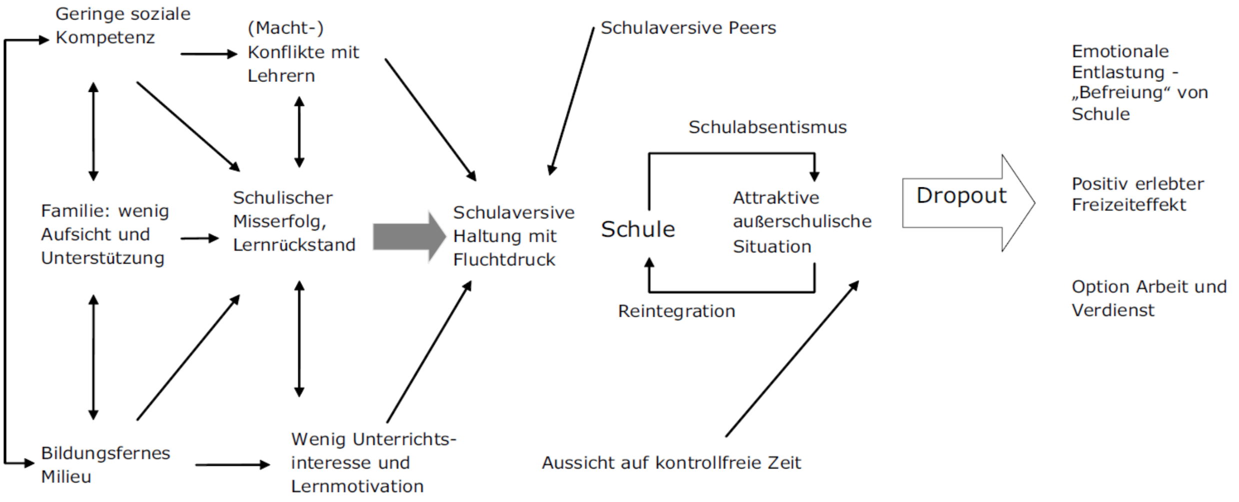
Gymnasium: ohne Abendgymnasien und Kolleg

Sonstige allgemeinbildende Schulen: Freie Waldorfschulen, Integrierte Gesamtschulen

In a comparison of school types, the number of school leavers without a school-leaving certificate remains constant; it is even down slightly compared to 2018. The high number of school leavers without a qualification in the area of secondary schools can probably be explained by the fact that a student with little or no school success does not leave the school system immediately, but first switches to a different type of school (gymnasium to junior high school, junior high school to junior high school middle school, for example) and finally after middle school there is no other type of school to choose from. In the next section, the reasons for early school leaving or school dropout are to be shown.

Causes of early school leaving or school dropout

Since we are dealing with a student with a human individual, the causes of early school leaving or dropping out are very complex and multidimensional. Although the causes can be divided into categories, these categories must always be viewed in conjunction with one another, as they often overlap. So, there is no single reason for early school leaving or dropping out. Rather, it is a multi-complex problem that does not necessarily have to come from the individual, but can also be caused by other factors, but ultimately always affects the individual himself.
Research agrees that in most cases of school leaving and school dropout, school avoidance or school absenteeism precedes it. Therefore, in the following, the focus is on the question of why children or young people avoid school. To answer this question, a categorization should be made. There are two opposing systems: on the one hand, the family system or the family (individual perspective) and on the other hand, the school system (institutional perspective). A diagram (chart 12), which integrates the categories of family and school, is intended to illustrate the development towards early school leaving as a model.



School absenteeism

In the specialist discussion, there is a broad consensus that school absenteeism must be made the responsibility of those affected themselves and their families. However, in recent dropout research, the role of school has been rediscovered and the realization has grown that schools have a far greater influence on dropout behavior than previously thought.[11] The research on school absentee behavior is so pronounced in comparison to the German-speaking area in the Anglo-American area because refusal to go to school is associated with a crime and therefore the school truant faces completely different consequences than is the case in Germany, for example. It has been recognized that absenteeism from school is closely linked to delinquency.[12] A large number of studies have shown that school absenteeism, which starts early and is massive, is a risk marker for impending undesirable developments, particularly for delinquency.[13] In the past, states and governments did not have this connection in mind, but are investing more and more money in this area of research, because the delinquency of young people who should actually go to school has turned from an educational problem to a political problem and is therefore of interest to society as a whole, because the delinquent behavior of young people often manifests itself in crime over time. In addition, the long-term consequences are extremely great: in other areas such as health, drugs and the professional situation, school dropouts have significantly more negative results. Many later depend on public support, change jobs more frequently, are affected by more health risks, commit more crimes and have higher divorce rates.[14]

The term school absenteeism stands for the absence from class for a reason not provided for by law, regardless of whether the parents are informed and legitimize this with excuses. A distinction is made between truancy and school refusal (school refusal, more common in Anglo-American-speaking countries: school phobia). School refusal, in turn, describes children and young people with enormous emotional behavior problems who – to the knowledge of their parents – are no longer able to go to school and show conspicuous psychogenic or

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11 Stamm, Margit: Schulabsentismus. Anmerkungen zu Theorie und Empirie einer vermeintlichen Randerscheinung schulischer Bildung, in: Zeitschrift für Pädagogik, Jahrgang 52 – Heft 2 März/April 2006, S. 285-302, S. 287.

12 Delinquency = the tendency to transgress primarily legal boundaries, that is, to become a criminal

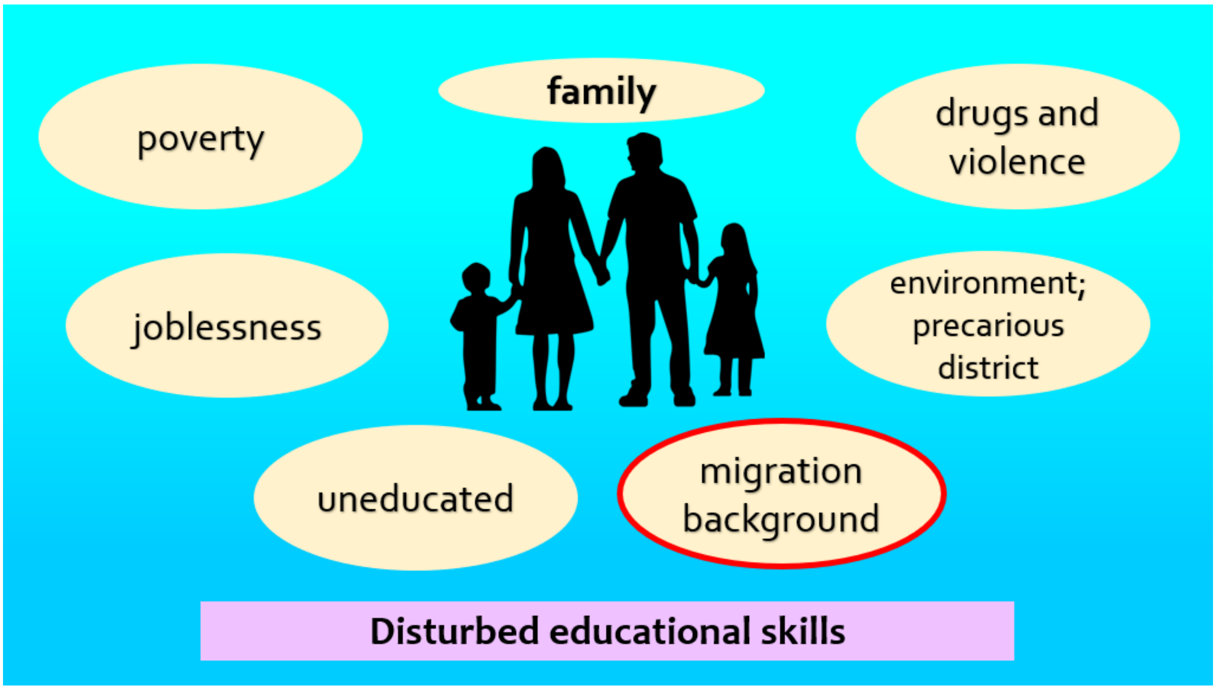
13 Stamm: Schulabsentismus, S. 288. Ein empirisch begründeter Kausalzusammenhang zwischen schulabsentem Verhalten und Delinquenz ist für den deutschsprachigen Raum nicht gegeben, S. 294.

14 Hillenbrand, Clemens/Ricking, Heinrich: Schulabbruch: Ursachen – Entwicklung – Prävention. Ergebnisse US-amerikanischer und deutscher Forschungen, in: Zeitschrift für Pädagogik, Jahrgang 57 – Heft 2 März/April 2011, S. 162.

psychosomatic changes in this context.[15] In contrast to refusal to attend school, truancy is only considered a trivial offense and hardly a condition factor for socialization risks. Rather, it is assumed that students know how to limit the extent of their violation of the rules in such a way that serious consequences are avoided. This understanding may be the reason why refusal to go to school is viewed more as a mental illness and in need of treatment, while truancy is viewed more as a harmless violation of the rules and, in rare cases, as pre-delinquent.[16]

Causes in the family system

The relationship between school absenteeism and family characteristics has been extensively researched. The older research still focuses on the sociological correlates such as parents without professional training, unemployment, family breakdowns or general stress in the family or both parents working. However, recent observations have shown that school absenteeism can be triggered by family stressors and in particular parenting practices.
For example, in families with above-average underachievers,[17] problematic parental control mechanisms can be found, which can be either distant and conflictual or particularly achievement-ambitious and overprotected.[18]
In principle, the causes of school absenteeism can be found in all milieus - even in a well-off family, there can of course be strokes of fate such as the death of a close family member or an authoritarian, punishing upbringing style. However, factors such as poverty, unemployment or violence and drugs, which are summarized in another self-created graphic (Figure 10), are more likely to be classified in uneducated and socially disadvantaged milieus.



[15] Stamm: Schulabsentismus, S. 286 f.

[16] Stamm: Schulabsentismus, S. 286.

[17] Highly gifted underachievers are students who show only moderate or poor school performance over a longer period of time despite very high-performance potential and above-average intelligence.

[18] Stamm: Schulabsentismus, S. 290 f.

The decisive factor is that these familial risk factors can be perceived by the students themselves and therefore form direct and highly effective influencing factors on the children and young people. A disturbed parenting competence of the parents limits the possibility of controlling the children's behavior or the disturbed behavior of the parents is transmitted to their children. In addition, parenting behavior shows another lasting influence on the development of school-absent behavior due to little emotional warmth in the parent-child relationship, little to no attention to the child's needs, insufficient supervision and insufficient support, e.g. with homework.[19]
Another central result of causal analyzes is that a low level of education of the parents, a migration background, which is associated with the fact that German is not spoken at home, and the educational distance of the parents have a strong negative influence on the learning outcomes of the children. These characteristics contribute significantly to the emergence of educational poverty. However, there is no reliable influence from the income of the parents. The level of education of the parents and their attitude towards education thus seem to have more of an effect on the learning achievements of the children than the income available.[20]
Dennoch wird die soziale Herkunft immer wieder als eine grundlegende Ursache von Schulabsentismus bzw. Schulabbruch angeführt. The explanation that there are more socially disadvantaged families and those with a migration background living in big cities than in the country
The explanation that there are more socially disadvantaged families and those with a migration background living in big cities than in the country[21], sounds plausible, but is only a weak argument when you consider that the financial resources of a big city are more considerable and that you give them completely different opportunities for support.
But before the question of how to counter school absenteeism can be clarified, the institutional perspective must first be considered.

Causes in the school system

In general, it can be said that the probability of absenteeism from school is relatively high if attending classes is not associated with positive emotional experiences for the affected pupil or if the experience of attending is perceived as more negative than the (short-term or long-term) negative consequences of an absence.[22] The aversion to individual school subjects and the avoidance of performance tests (10 to 40 percent), rejection of the school as a whole (33 to 66 percent), conflicts with teachers (15 to 27 percent) or experiences of violence by classmates (bullying, one to 19 percent) are among the most common motives. In this way, when students do not get along with the teachers, they remain firmly convinced that their presence at school is not of primary importance and that the teachers are not interested in them and do not want to help them either.[23] On the other hand, it can be shown that the higher the students' own well-being and the better the relationship with the teachers, the lower the school absenteeism or school-leaving rates.[24] There is also a connection between regular performance tests carried out

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19 Hillenbrand/Ricking: Schulabbruch, S. 158 f. und https://www.mdr.de/nachrichten/sachsen-anhalt/landespolitik/kein-abschluss-die-zweite-chance-nach-dem-schulabbruch-100.html

20 https://www.bpb.de/shop/zeitschriften/apuz/30383/bildungsarmut-auswirkungen-ursachen-massnahmen/

21 https://www.abendzeitung-muenchen.de/muenchen/ueberdurchschnittlich-viele-schulabbrecher-in-muenchen-art-378330

22 Hillenbrand/Ricking: Schulabbruch, S. 158.

23 Stamm: Schulabsentismus, S. 292.

24 Stamm: Schulabsentismus, S. 293.

by a school or type of school. Because these performance tests tend to move away from the individual-oriented assessment norm and in turn increasingly divide students into high-performers and under-performers. But such a division promotes school failure, because underperformers quickly get into a downward spiral. Poor leadership leads to low prestige among teachers and peers, which in turn leads to behavior that is further negatively rewarded.[25] Most affected students often experience relief from pressure, fear and control upon leaving school. There is a positive leisure time effect that reinforces the avoidance behavior so that it is continued.[26] But the desire to be with friends who don't attend school is also an influencing factor that should not be underestimated, which is why the influencing factor peer group (abbreviation = peers)[27] should be counted as part of the school system here, although it is between family and school is located and could be defined as another independent factor.[28]
The side scenes of school, such as breaks or the way to school, have become attractive social centers for adolescents to this day, because schoolchildren mainly come to school to meet their friends. If, for example, the demonstration of school distance in peers promotes status, this has a particularly influential effect, since young people influence each other's behavior. In their groups, the young people develop their "own world" with specific ritualized forms of behavior, internally sophisticated assignments of positions and often massive isolation from the outside world[29]. Such groups thus embody a power to define school that must be taken seriously, because they deliberately include random school absentees. They become all the more powerful the more clearly there is a school-distancing culture in the classroom, which makes integration difficult and promotes stigmatization; the more isolated and unpopular young people are and the more massive fear dominates in the sense of blackmail, threats or beatings.[30] The risk that a student will build up a serious distance from school, which can ultimately lead to dropping out of school, increases many times over if there are contacts with friends who abstain from school.[31]
Other influencing factors that can emanate from the school are, for example, the size of the school: is it a large school in the city with many students or a rather small school in the country? The environment – city or country – also plays an explicit role as an influencing factor. At least the pupils who grow up in a rural area are considered to be better brought up or it can be assumed that the parental home is intact in the sense of enough parental attention to the children and sufficient support in coping with school. Also noteworthy is the observation that the probability of school absenteeism increases when there are shopping facilities close to the school. A larger shopping center, for example, offers young people an ideal place to escape from class, mostly undetected by the police or the like.[32] Factors that relate to the internal workings of the school are included and explained under the aspect of counteracting early school leaving.

Counteract school dropout

[25] Stamm: Schulabsentismus, S. 293.

[26] Hillenbrand/Ricking: Schulabbruch, S. 163.

[27] Peer group is a highly influential social group that an individual feels a part of. The peer group is particularly important in adolescence. There, the feeling of belonging often results from age equality.

[28] Stamm: Schulabsentismus, S. 187. und Hillenbrand/Ricking: Schulabbruch, S. 159.

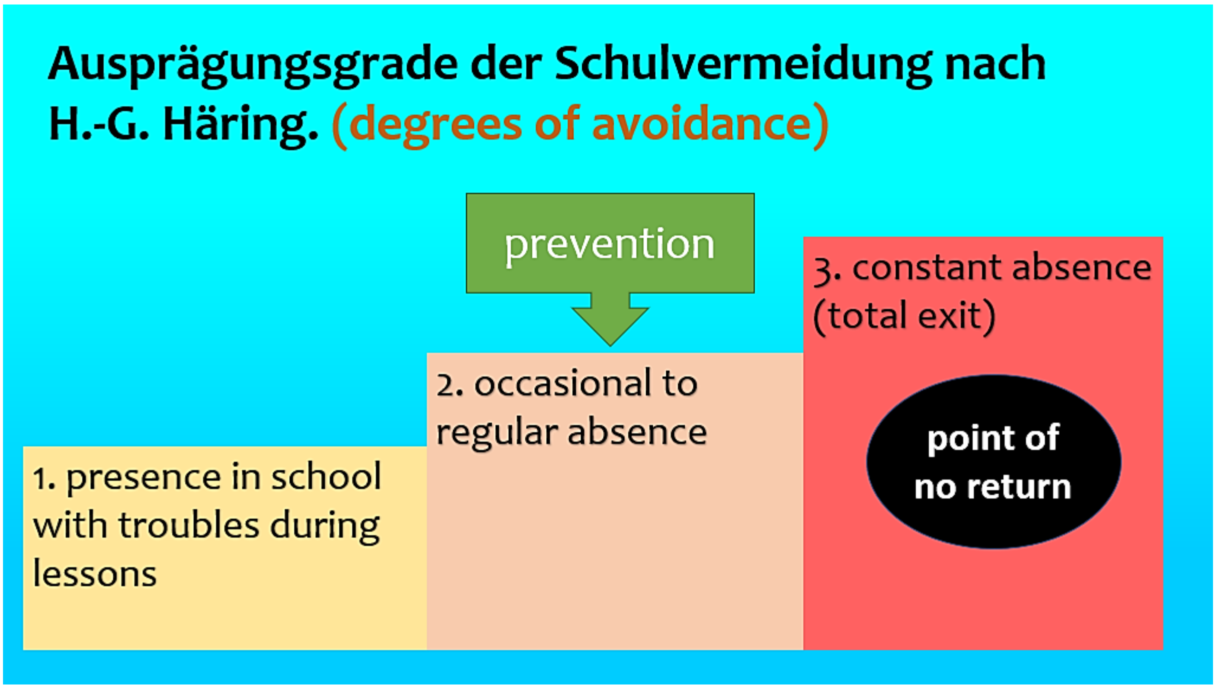
[29] Hillenbrand/Ricking: Schulabbruch, S. 160.

[30] Stamm: Schulabsentismus, S. 191.

[31] Hillenbrand/Ricking: Schulabbruch, S. 161.

[32] Hillenbrand/Ricking: Schulabbruch. S. 160.

At the outset, the causes of the emergence of school absenteeism were shown. Based on H.-G. Häring differentiates between three degrees of severity, which are shown in a self-created diagram (Figure 11).



The decisive factor here is that there is a high probability of early school leaving or dropping out of school for pupils who have experienced constant absenteeism. From this point, the "point of no return", it is very difficult for pupils to reintegrate into the school system.[33] It is therefore crucial that the causes are recognized much earlier and that preventive measures are taken before the last degree of severity.[34] For this reason, the measures that only take effect after school has been dropped out should only be presented briefly at the end. Support programs that are carried out outside of the school and are more of a political instrument cannot be mentioned here either. Because so far, the preventive measures in schools have proven to be the only sensible and sustainable measures in terms of avoiding or reducing school drop-outs and early school leaving. If it is an illness-related reason why a student avoids school, the first thing that needs to be done is for professionals to make an assessment. For example, the school psychologist can be consulted, who can recommend further steps such as therapeutic support or similar. Accompanying measures that can be carried out by the school itself are, for example, a reduced timetable for reintegration after a student has been absent for a long time or the suspension of grades in the case of proof of performance in order to minimize the pressure to perform. However, since the causes described at the beginning of an illness-related outweigh, only school-based prevention options are addressed in the following. According to Hillenbrand and Ricking, the relevant measures can be divided into three groups:[35]

1. Individual-related support programs

2. Ecological, i.e. approaches that include the social environment and

33 Hillenbrand/Ricking: Schulabbruch, S. 162.

34 https://www.isb.bayern.de/download/1867/schulvermeidung.pdf, S. 2.

35 Hillenbrand/Ricking: Schulabbruch, S. 165-168.

3.Transition programs accompanying the social environment.

In order to effectively counteract school absenteeism, the management of the school, from the school administration to the individual teacher, must be well organized. Here, the measures can be set within the framework of a contingency agreement between the pupil and the school management. The contract can be oral or written and specifies what specific reinforcements or consequences will follow the absent or non-absent behavior. Pupils with high-risk conditions should undergo an intensive and highly individualized intervention, which, for example, provides for morning calls at home and home visits and, at the same time, supports these pupils in learning social behavioral skills and offers close-knit learning support. However, classroom management is much more important: “No other feature is so clearly and consistently linked to the performance level and learning progress of school classes as class management, so that successful classroom management makes a significant contribution to the prevention of school absenteeism […]. “[36] This means that a lot of responsibility and weight lies with each individual teacher. Are clear processes and routines established in the classroom? Are expectations of student learning and behavior clearly articulated? If a student is absent frequently, the teacher must react quickly and take action, or the absence must not be ignored. In this regard, a continuous exchange with the parents is eminent for the teacher as well as for the school management. The classroom management should also involve the students in the everyday processes of the school (social integration), for example by means of a tutoring program. The bond between the students and the teachers is also an important basic principle, because a good relationship with the teachers strengthens identification with the school and increases motivation. In this regard, activities outside of the classroom in the form of AGs are useful, and school festivals or similar can also succeed in tying the parents more closely to the school. The transition from elementary school to a new type of school is often a major challenge for many students. In order to make this transition easier for the students and to increase the bond with the teacher and identification with the school, the classroom can be established - and class teacher principle at secondary schools could be a possible solution. The subject teacher principle in secondary education has long been identified as a major problem, but unfortunately there is no change in sight.
The research and efforts of the last decades and a reduction in school dropouts and school leaving are summarized in 15 individual measures that pursue four basic strategies and can be read in full at Hillebrand and Ricking:[37]

1. Involvement of the school in the community. (Also, cooperation with the police)

2. Early interventions. (Activation of family commitment; educational opportunities for children; consistent learning support)

3. Basic strategies for dealing with at-risk students. (Mentor and tutor program; extracurricular learning opportunities)

4. Improved teaching-learning strategies. (Further training for teachers; technical learning support in the classroom; support in the transition from school to work)

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[36] Zit. Hillenbrand/Ricking: Schulabbruch, S. 166.

[37] Vgl. Hillenbrand/Ricking: Schulabbruch, S. 167.

The measures presented at the beginning to prevent school absenteeism and thus also to reduce the number of school dropouts can of course still be expanded. A consideration of how digitization can change the school and how the corona pandemic has changed the students and will thus also change the school is still pending. The first research reports on this have recently been published and must be implemented in the so-called dropout research. The embedding of preventive measures in everyday school operations requires structured guidance and regular further training for all pedagogical specialists and thus also an enormous amount of human capital. In view of the fact that the shortage of teachers in Germany will probably not improve over the next few years and that the pupils may have suffered massive disruptions in their learning behavior due to the corona pandemic, schools will face a difficult task if they do not are already dealing with the consequences. It is doubtful whether the current numbers of early school leavers and school dropouts will remain. The question remains open as to whether the current strategies and measures will be sufficient to lead the pupils to a successful school leaving certificate or whether the school system will change or adapt accordingly to the overall situation

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Illustrations

1. Grafik 2: https://www.iwd.de/artikel/zahl-der-schulabgaenger-ohne-abschluss-steigt-wieder-480556/ (22.10.2022)
2. Grafik 3: https://www.iwd.de/artikel/zahl-der-schulabgaenger-ohne-abschluss-steigt-wieder-480556/ (22.10.2022)
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INTRODUCTION

This day and age`s demands for highly skilled people are augmented, as to serve the growing needs of the job market. Despite this, a vast number of children drop out of school before the completion of their mandatory schooling.

The negative effects that early school abandonment has on the job sector and society in general are multiple. School drop-outs have trouble joining the work force without some basic necessary skills, while simultaneously they become overwhelmed with feelings of inferiority. A direct consequence of the seissocial exclusion.

This presentation's goal is to make known both the causes of early school drop-out and the effects it has on the individual's life.

DEFINING EARLY SCHOOL DROP-OUT

Any society defines, controls and forges laws for its educations system. The term ”School Drop-out” or ”School Abandonment” is directly correlated with the specific kind of educational system of each individual country and society.

Therefore there is no concensus on the definition of the term.

In educational terminology ”School Drop-Out” or ”School Abandonment” is defined as the preemptive termination of school attendance before getting an official diploma.

The most commonly used definition refers to the complete abandonment of an individuals schooling before the completion of their mandatory education.

The official mandatory schooling in Greece lasts for 9 years.

It begins with the 1st class of Primary School and is finalized with the completion of the 3rd class of High School. (Greek Constitution, 1975, Article 16, Par. 3).

The aforementioned term also refers to individuals who have dropped out before getting their Middle School diploma.

SCHOOL ABANDONMENT IN GREECE

The school drop-out rate in Greece has been reduced but remains significant. The latest report was produced by the Office for Research and Evaluation of Education, IEP in 2019 and concerns the "Reduction and prevention of early school leaving".. The study was prepared by the staff of the Office for Research and Evaluation of Educational Work of the IEP, which is responsible for issues of recording and addressing student drop-out.

IEP consists that beyond the exact percentages of mathematical dropout, it is important to keep in mind that student dropout, even if it concerns a single child, is critical not only to that child's life but also to their wider environment. That it is critical that a child or adolescent in school does not interrupt his/her studies, remains in the school community and enjoys the right to education cannot be disputed in a modern society. Therefore, beyond the macro-view of the phenomenon of student dropout, which is necessary for the design of appropriate educational policies and interventions at central and regional level, the importance of the micro-view of the phenomenon should not be overlooked: they should be investigated for each child or teenager separately, the conditions that lead out of school and consequently out of the perspectives that it opens up. The role of teachers and the local educational and school community is considered crucial.

Finally, it is emphasized that the data of the study come from male and female students enrolled in Primary and Secondary Education structures and the student dropout is calculated on the given student population. The question still remains unanswered regarding the exact number of children and adolescents who live in Greece, but have never been enrolled in Primary and Secondary Education structures (e.g. children with a migrant background), or children and adolescents whose the course is not tracked through the information system.

The report covers students in the 2014-2015 school year.

The largest percentage of school children drops out of primary school, a smaller percentage terminates schooling on the 1st or 2nd class of middle school, whilst drop-outs from the 3rd class of middle school constitute the minority.

Drop-out rates are higher for male student compared to female students.

As it pertains to geography, areas in West Peloponnese, the Greek Isles, Central Macedonia and Thrace present the largest drop-out rates.

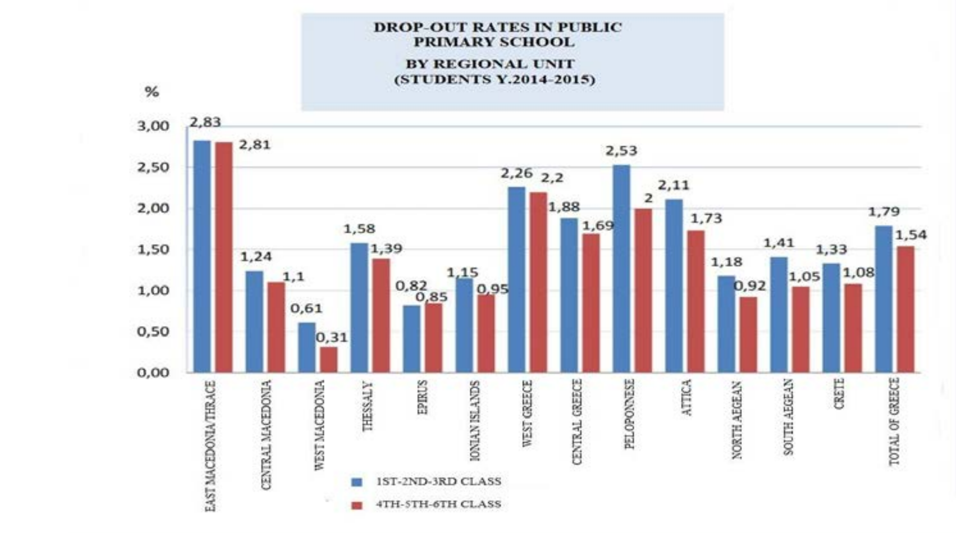
The high drop-out rates in the Greek Islands (and in general in places with a highly developed tourist industry) are attributed to the early engagement of young people with the tourist sector's job market.

PRIMARY EDUCATION

Regional units such as Xanthi, Rhodope, Achaea, Elis and West Attica have the highest rates of school drop-out rates. Children that drop out of school in these regional units often come from a low income, agricultural, low or middle class backround. Job prospects for these children often revolve around family farms and small family businesses.

Island regional units such as Heraklion, Chania, Corfu and the Dodecanese also present high drop-out rates. The developed tourist industry and the fast amassment of capital in those areas are considered the primary causes of this phenomenon. The rates are been shown at graph1.

Graph 1. Drop out rates in public primary school by regional



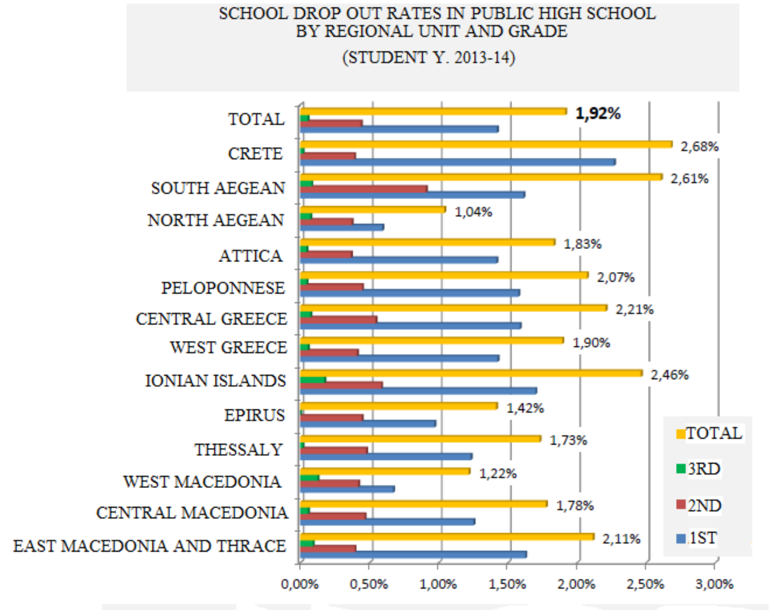
Source: Informational system myshool (Aug.2017). processing: Office of research and evaluation of educational work IEP

The rates of drop out are higher in East Macedonia and Thrace, following by Peloponise.

SECONDARY EDUCATION

In secondary education most drop-outs don't attend the1st class of middle school at all. A smaller percentage drops out when in the 1st or 2nd class. A minute percentage abandons their schooling in the 3rd class of middle school. The values are been shown at the 2nd graph.

Graph 2. Drop out rates in public high school by regional



Source: Informational system myschool (Aug.2017). processing: Observational office of school drop-out rates IEP

In many researches find out that there are issues of transition, whether from primary to post-primary, or middle to upper secondary, or from preschool to primary are also related to ESL. The rates of school drop out are raising in the Greek islands.

The rates of drop out in public middle school through the time are presented in graph 3.

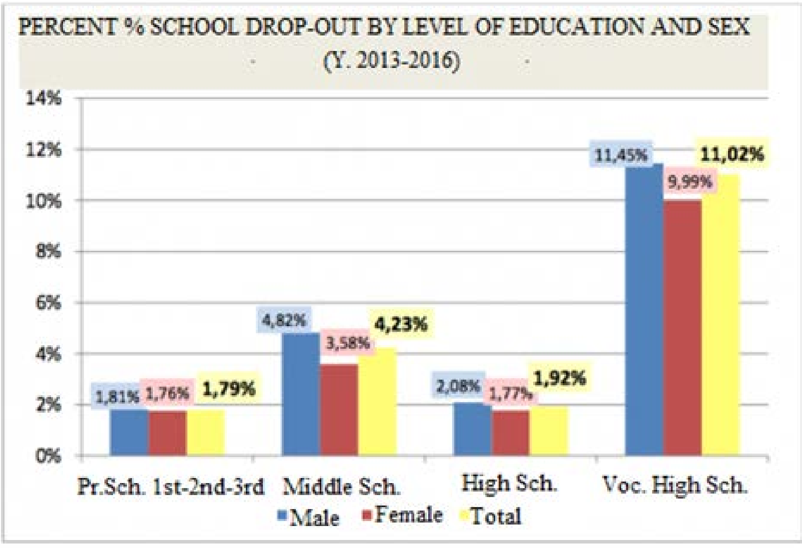
Graph 3. Drop out rates in public middle school through the time

Source: Informational system myschool (Aug.2017). processing: Observational office of school drop-out rates IEP

The maximum was at 1990-1991 as indicated by the 3d graph. Since then the drop out is minimize year by year.

Examining school dropout by gender, the results are shown in 4th graph .

Graph 4. Percent school drop out by level of education and sex.



Source: Informational system myschool (Aug.2017). processing: Observational office of school drop-out rates IEP

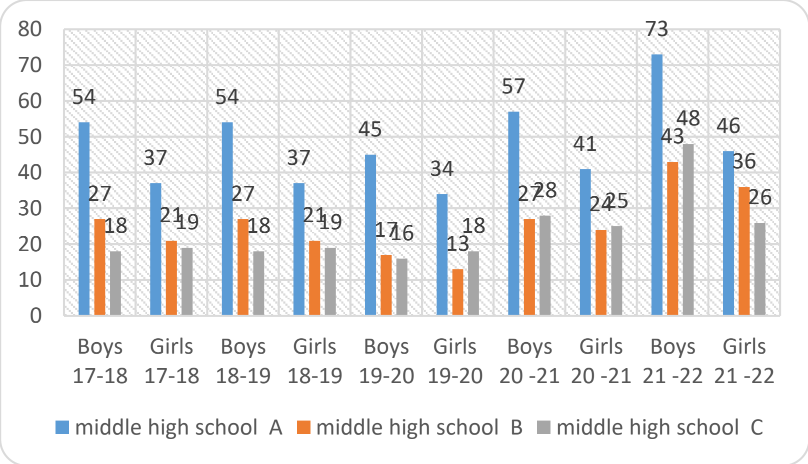
Graph 4 shows that the values of school drop out for boys are higher than those for girls. We also see that as the level increases the values are rising.

South Aegean area of Dodecanisa

At the graph 2 we observe that South Aegean the values of drop out is 2,61% . There are not official numbers of the students that drop out from secondary school but there are the statistics of the students that failed to pass the grade that they attend for the years of 2017 until 2022.

The situation in Rhodes that belongs to South Aegean islands is been shown in graph 5. At the graph are given the values of the students that failed to finish on time the grade that attend. There is no any information if they give up the school or not.

Graph 5. Numbers of students that failed to finish the school in middle high school in North Aegean islands

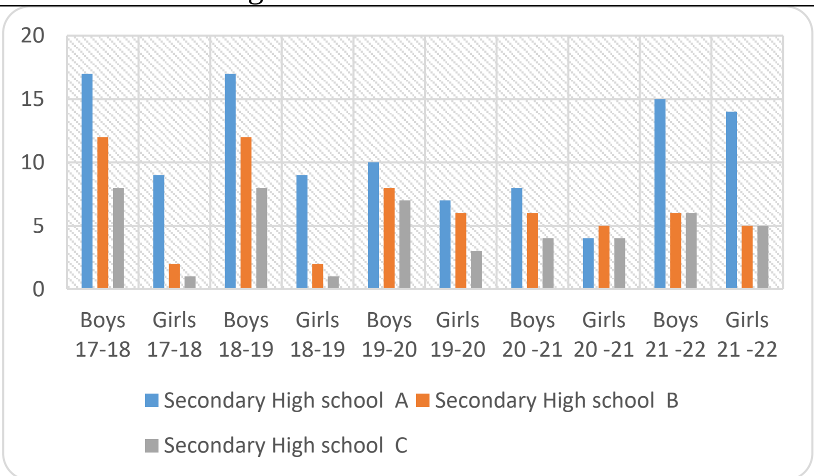


Source: Deyterovathmia Ekpaideysi Dodekanisou (Secondary Education of Dodecanisa)

At the 5th graph it is observed that students who have just made the transition from primary to secondary school find it difficult to successfully complete grade A. For the next two grades the values are decreasing.

At the 6th graph is provided the values of the students that failed to pass the grade that they attend at the secondary high school.

Graph 6. Numbers of students that failed to finish the high school in North Aegean islands

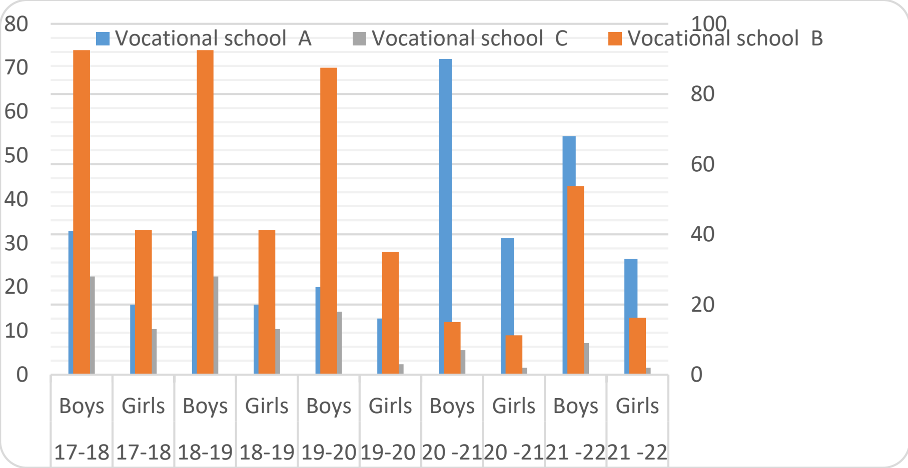


Source: Deyterovathmia Ekpaideysi Dodekanisou (Secondary Education of Dodecanisa)

At the 6th graph it is observed that students who have just made the transition from secondary middle school to secondary high school find a difficulty to successfully complete grade A. For the next two grades the values are decreasing.

The valus of the students that they haven' t manage to complete the class in time at the vocational schools is been shown at the 7th graph.

Graph 7. Numbers of students that failed to finish the vocational school in North Aegean



Source: Deyterovathmia Ekpaideysi Dodekanisou (Secondary Education of Dodecanisa)

The 7th graph doesn't follow the motive of the secondaries middle and high school for the years of 2017 until 2020 but for the years afterwards the number of the students at the first grade increases very fast.

The curriculum program must change to make easier for the students the transition from one level to another. Also the school should be pay attention of the new entrance students.

At 4th GEL of Rhodes 7 students left for vocational school, but two of them return back. Three students failed to finish last year the school. The two of them moved abroad so we don't have icon of them and the third one come back to finish the school.

Factors contributing to the reduced rate of school

As mentioned before, the rate of school abandonment is markedly reduced the last few years, however as a problem it remains significant.

Factors contributing to the reduced rate of school abandonment are the following:

1. <u>EDUCATION IS NOT CONSIDERED AS LUXURY ANYMORE</u>

Social and economical development of the individual and society in general is directly linked to the individual's education.

2. <u>THE EDUCATED INDIVIDUAL REMAINS A PARAGON</u>

Event though we are going through an age with few role models, the highly educated individual that works under good working conditions, has a balanced personal life and is highly paid, remains a paragon for today's youth.

3. <u>CHANGES IN THE JOB MARKET</u>

Sectors such as tourism, communications and the new technological advancements necessitate a highly skilled work force, one that is versatile enough to cover the vastly changing demands of each sector.

On the contrary, the diminution of the rural sector, the closures of factories, industries and family businesses along with the addition of the incoming foreign work force have a negative correlation to the demand for unskilled labor.

Letus note that in the E.U. the unemployment rate within people who have received a high level of education is significantly low.

4. WOMEN'S EDUCATION

The working woman is now an integral part of the work force, even in areas of the job sector that in the past where considered male professions. The traditional roles attributed to both sexes have become obsolete. At the same time the law recognises and protects womens' rights, specifically those pertaining to their livelihood. All these factors necessitate women having access to higher education.

5. ADVANCEMENTS IN EDUCATION AND SOCIOECONOMIC PROGRESS IN GREECE

A significant rise in the Greek populace's socio-economical level and level of education has been observed up until the year 2008. The Greek familial unit faces some difficulty maintaining this quality of life today.

6. The mandatory schooling in Greece lasts for 9 year since 1975.
7. Low performance students are supported progressively more by the educational system.
8. .BETTER MENT OF THE COUNTRY'S ROAD NETWORK

A better road network and more available and frequent choices of public transportation, those result in children from the most distant villages or islands in Greece being able to attend school.

9. .LOWER BIRTH RATES AND EDUCATION

The last few years another problem Greece faces is the progressive drop in birth rates. The reduced numbers of young people necessitate the achievement of the maximum level of education available, so that they remain competitive in the global job market.

The drop-out rate has obviously dropped, however it still remains a core issue. To give an adequate solution to this problem, it is vital to forge a correct educational policy.

FACTORS AFFECTING SCHOOL DROP-OUT RATES

Why does the drop-out phenomenon exist? What are the factors affecting school drop-out rates, both globally and in Greece specifically?

There is proof that a significant universal factor affecting drop-out rates is the family environment. The school environment is also a significant factor, as agreed upon by the directly involved educators, still the family seems to have a greater effect.

PRIMARY EDUCATION

The percentage of students who are rejected from primary education is practically zero. Mostly external factors, such as diseases, would not allow a student to attend their lesson plan.

SECONDARY EDUCATION

The school drop-out rate is definitely higher in the secondary level of education. The higher demands for the teenagers school performance are massive. Low school performance, being late for school, a negative stance towards the education system, early school failure, attitude problems, absenteeism, repeating a school year, lacking school participation, juvenile delinquency and other relevant factors cause as a result higher rates of school abandonment in Greece.

According to the Ministry for Education and Religion, the reasons for higher drop-out rates can be summed up as follows:

1) SOCIAL

Such as the traditional values system, scorn of studies shown by the job market, race and ethnic backround.

2) FAMILIAL

Among those are the low socioeconomic status of the family, parents with a low education level, the lack of familial support towards the young family members, low parental expectations from the student, negative behavioral patterns or neglect by the parents, instability of the environment at home.

3) PERSONAL

Low self-esteem issues, lack ofextracurricular interests, learning difficulties, multiple absences from school, charged interactions between students and faculty members, stress, school failure.

4) EDUCATIONAL

Low quality of teaching, insufficient lesson plans, the examination system lack of an adequate number of faculty members to combat various social issues (such as psychologists and social workers).

5) POVERTY

Children of monetary challenged families often choose to work, to support the family's income. Children that come from rural areas, remote villages or impoverished sub-urban areas, children of families with a low or diminished income or with illiterate parents are much more likely not to finish their obligatory schooling.

6) SPECIAL CATEGORIES OF CHILDREN

Children of economic migrants, those who reached Greece under harsh conditions, trying to avoid the wars being waged in their home countries. Those children, faced with Greek as a foreign language, have higher chances of dropping out of school. Highratesofschoolabandonmentare also present among children of the Romani minorities, who oftentimes also live under harsh conditions.

CHILD LABOR

Child labor is also a significant factor among the causes of school abandonment. It mostly affects multiple agricultural areas globally and more specifically in Greece where the tourist industry is highly developed, as the children inhabiting those areas often get involved with the agricultural and tourism sector beyond what would be considered appropriate for their age. Usually it pertains to children of low income families, with parents who are illiterate, refugees, economic migrants and children of racial (e.g. Romani) or religious minorities.

SCHOOL ORGANISATION MODEL

The school organisation system does not have the necessary flexibility and adaptability to assist students with learning difficulties. Thereisnoprovisionfortheindividualization of the school program, the admittance of students in classes with people of similar capabilities e.t.c.

Every grade has one or more classes, where the students usually attend as a result of the alphabetical order of their names or their choice of foreign language to study. Theseparationwithinclassescouldbedoneaccordingtochildrens' individual skillsets as it pertains to their schooling.

The number of students per educator is also significantly high, resulting in classes with 15, 20 even 27 students. Thisofcoursemakestheeducating process all the more difficult.

The scale of school abandonment is directly correlated with a multitude of characteristics of the schools in question, such as: the size of the school building, the teacher-student ratio, the disciplinary and school performance evaluation systems, the quality of the school environment, whether it encourages or discourages the appearance of antisocial behaviours. the lesson plan, the school's ability to care and support the attending students, especially when it come to academic or behavioural problems.

SCHOOL FAILURE

School failure is a major cause of school abandonment in middle school. A simple definition of school failure in generally described as a student's inability to perform according to the demands of the lesson plan, to absorb new knowledge to achieve his or her goals.

Theaforementionedphenomenonhas multiple different facets on a social, personal or political level.

✔ On a social level, school failure means that the student does not have the necessary tools to dynamically and equally to their peers shape their future, or to climb the social ladder in an environment that treasures knowledge and a high degree of specialization. School failure becomes a definitive factor of the individual's social identity and social inclusion.

✔ On a personal or family level, schoolfailure is often seen as a personal failure of child. It is rare for the family to look into their own contribution to this issue. This outlook may cause the child to feel inferior, have low self-esteem, depend entirely upon the parental figure or feel indifferent. All these inside a family setting may be a cause of constant pressure, anxiety and stress. The childs prospects for success and fullfillment of their personal goals are put into question. The child's ambitions are seen as lesser when compared to the family's expectations, becoming a constant source of disappointment and lack of pride for the child's abilities.

ECONOMIC CRISIS AND SCHOOL ABANDONMENT

The educational ststem in Greece could not remain unscathed in the face of the economic crisis ravaging the country.

Violent episodes and thefts are often enough experienced in the school setting, most likely the result of economic struggles within the Greek family. Bullying, whether it is verbal or physical, as well as getting into verbal fights with their educators are obviously factors facilitating school abandonment as they could lead the student to expulsion and removal from the school environment.

Harsh living conditions are a source of psychological pressure, leading the child to behaviours such as those described above.

The parents' monetary destitution, the rise in unemployment and the general sense of social instability are all things mirrored in everyday school life. Early departure from the school setting comes naturally as a direct consequence.

To the child's inability to follow through the educational process in Greece contributes the lack of affluence to join extracurricular remedial lessons. Those are considered of vital importance, especially to highschool students attending the current Greek educational system.

Of course the general sense of not fitting-in is enhanced by the economic struggle to acquire clothing and food similar to their non-struggling peers in the school environment.

COVID-19 AND SCHOOL ABANDONMENT

After the first wave of the COVID-19 pandemic hit, online distance learning came into effect as a means to combat the spread of the virus. This measure was adopted by the vast majority of countries.

Online distance learning brought an already known issue to the spotlight: children from socially or economically disadvantaged households were those affected the most as a consequence to their schools closing during lock-down.

Difficulty accessing the web, lack of access to the appropriate technology, lack of basic skills when handling said digital technology, even some inability to find a quiet place at home to study, all those are limiting factors to the students'consistent participation in distance learning.

The economic struggles of the families of those children when faced with the technological demands of distanced learning has negatively affected the already significant issue of school abandonment.

CONSEQUENCES OF SCHOOL ABANDONMENT

An asasummation, of the consequances, of early school abandonment areas follows::

On a personal level, an individual could potentially remain faced with the consequences of dropping-out of school for the rest of their lives. Participation in social, cultural or economical facets of everyday life becomes unlikely. Acquiring a lower than average income affects their wellbeing and their health. Early school abandonment raises the chances of the individual having to deal with unemployment, poverty and social exclusion.

On the broader socioeconomic level, early school drop outs usually do not participate as often in the democratic processes and are not as active in their civic duties. As result this could negatively affect the populaces social and economic development in the long run.

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3.6 ITALY

What is school dropout

"School has only one problem: the kids it loses," so wrote Don Lorenzo Milani sixty years ago in Letter to a Teacher. The kids the school "loses" should be a major concern not only for parents and teachers, but of the entire school system and even the entire political apparatus.

School dropout is defined as the failure or incomplete or irregular utilization of educational services by school-age children.

School dropout phenomena include:

- total nonschooling even at the initial levels of education;
- dropout, that is, the interruption, mostly permanent, of educational courses;
- repetition, that is, the condition of those who have to repeat the same course previously attended with negative results;
- lateness, such as temporary interruption of attendance (for a variety of reasons) or withdrawal from school for certain periods of time.

The set of dropout phenomena, in addition to having legal consequences in some cases (Italy has compulsory schooling until age 16), have a negative impact on public costs for education, as well as on family budgets. However, the most significant consequences of this phenomenon affect the sociocultural reality and economic development prospects of countries.

Young people who leave school having attained at most lower secondary education face greater difficulty in finding a job and have limited employment prospects; have lower participation in social, political and cultural activities; and are at greater risk of poverty and poor health.

The data

Data on early school leaving come mainly from three sources: the Ministry of Education, University and Research (MIUR), INVALSI and ISTAT.

On the other hand, as for the international situation, one of the most recognized surveys aimed at ascertaining school learning is the PISA project, sponsored by the Organization for Economic Cooperation and Development (OECD), which, every three years, ascertains the skills of 15-year-old schoolchildren in the areas of reading, mathematics and science. PISA is an extensive survey around the world that involved 79 countries/economies in the last cycle of 2018. To measure the impact of the pandemic from Covid-19, it is necessary to wait for the results of the cycle that took place in 2022 and will be published in late 2023. However, the report published by the OECD in September 2021, in collaboration with UNESCO, UNICEF and the World Bank, estimates that learning disruptions caused by the pandemic could lead to a 25 percent increase in the share of secondary school students performing below the OCSE PISA 2 level.

MIUR data

MIUR's data are calculated based on numbers from the National Student Registry, which each year becomes more accurate in its mapping of pupils attending Italian schools. The following categories enter into the calculation of dispersion:

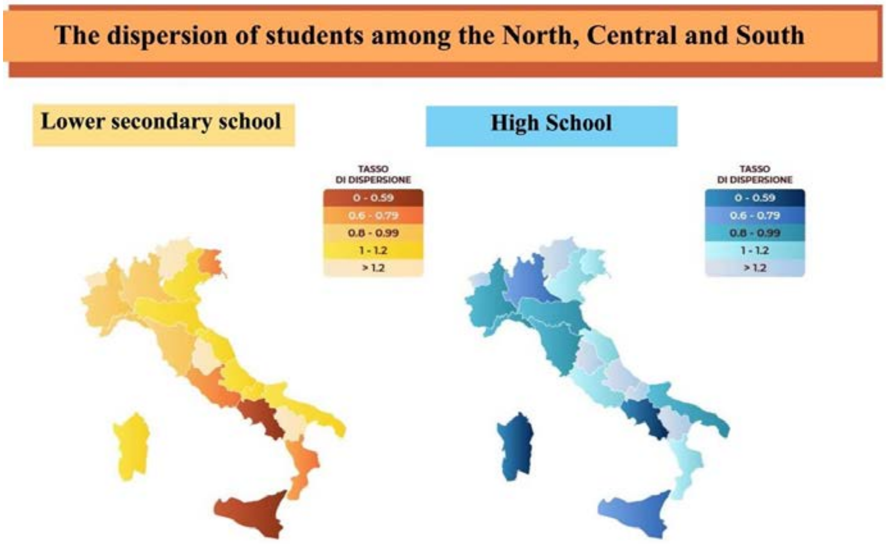
- Pupils who attend secondary school and interrupt attendance without a valid reason before the end of the school year (dropout during the year)
- Pupils who have attended the entire school year of Lower secondary school Grade and do not pass into the following school (dropping out between one year and the next)
- Pupils who have attended the entire 3rd Lower secondary school year, have taken the final I-cycle exam, do not pass in the following school year to the 2nd grade secondary school, in good standing, nor do they re-attend the 1st grade secondary school, as repeaters, nor do they enroll in IeFP pathways, nor in first-level pathways at CPIAs or in second-level

education pathways at 2nd grade educational institutions (dropout in the transition between cycles)

- Pupils who attend secondary school and discontinue attendance without a valid reason before the end of the school year (dropout in the course of the year - secondary school);
- Pupils who have attended the entire school year, the I, II, III or IV year of the secondary school of II grade, who do not advance in the following year either to the II, III, IV or V year in good standing, or to the I, II, III or IV year as repeaters, or enroll in IeFP pathways, first-level pathways at CPIAs or second-level education pathways at II grade educational institutions (dropout between one year and the next - secondary school of II grade).

According to MIUR's report, 9,445 pupils, or 0.56 percent of the national total, dropped out of middle school in the 2018-2019 school year and in the transition to the 2019-20 school year, while another 6,322, or 0.37 percent, dropped out in the transition between the first and second school cycle. In high school, the numbers were higher; in fact, there were 86,620 dropouts, or 3.33 percent.
So 102,000 students dropped out of Italian schools in a single school year. This is a worrisome figure, destined to accumulate to those of previous periods and to worsen as a result of distance learning consequent to the pandemic problem.

The dropout rate is determined by measuring the share of ELETs, Early Leavers from Education and Training, that is, young people aged 18 to 24 who do not earn more than a high school diploma or a qualification of a maximum duration of 2 years.
School dropout in Italy is a complex and heterogeneous phenomenon; in fact, it is affected by several variables such as gender, socio-cultural affiliation, and geographic affiliation. In both middle and high school, for example, this phenomenon affects mostly males. According to the report, 0.59 percent of males drop out of middle school compared to 0.51 percent of females, a gap that grows in high school (4 percent of males and 2.6 percent of females).
School dropout, moreover, is more consistent in the South, where for middle school the highest rates are found in Sicily, Calabria and Campania. For high school the picture is similar, but with proportionally higher numbers: here dropout rates are 4.5 percent in Sardinia, 4.1 percent in Campania and 3.9 percent in Sicily. They are followed, not too far behind, by Lombardy, Liguria and Tuscany, all with rates above the Italian average of 3.3 percent.

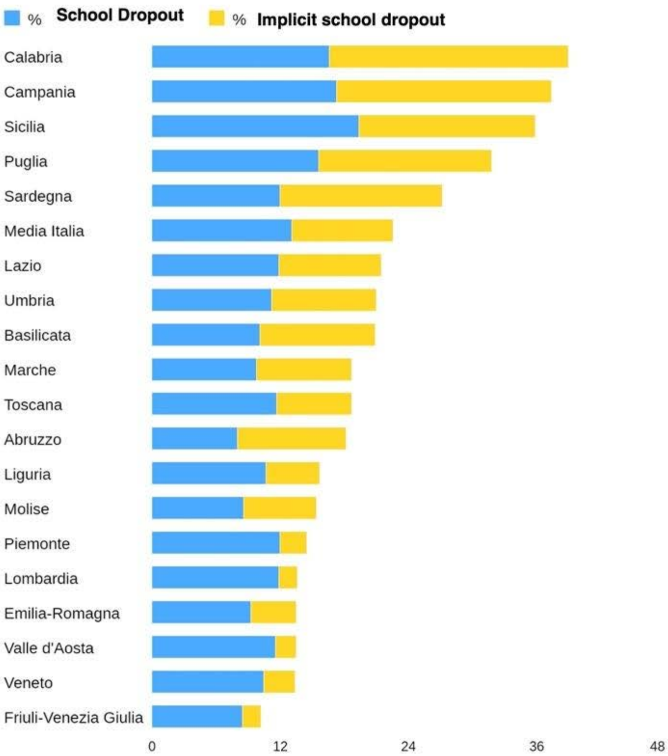


School dropout in Italy affects foreigners more, who drop out of middle and high school much more than Italians. The dropout rate among foreign children is almost 25 percentage points higher than among their Italian peers. Linguistic and cultural barriers and the economic conditions of the family of origin, which are on average more disadvantaged, hinder the integration of foreign children in schools, particularly exposing them to the risk of educational poverty. Remarkable is the difference between foreign pupils born in Italy and those born abroad: the latter find themselves in greater difficulty than those born in Italy.
Finally, for high school, the phenomenon differs among the various study paths. The lowest dropout rate is in high schools (1.6 percent), followed by technical institutes (3.8 percent) and vocational institutes (7.2 percent). The highest dropout rate is in regional IeFP (Vocational Education and Training courses under regional jurisdiction), with an overall dropout rate of 7.9 percent.
The most critical moment is the transition between middle and high school. In the delicate transition between the two school cycles, 6,322 pupils dropped out of school, accounting for 1.14 percent of those who attended the third year of middle school.

INVALSI data

INVALSI data also show a rather widespread phenomenon that often escapes statistics: implicit school dropout. A not insignificant share of students who graduate but do not reach the levels of proficiency that should be expected after thirteen years of schooling. In Italy, the share of ELETs, according to EUROSTAT 2019 data, still stands at 14.5 percent of the school population in 2018. The figure on ELETs, however, fails to give the exact dimension of the dropout problem, as it eludes those students who earn a high school diploma but have not achieved the minimum skill milestones required by their course of study.
Implicit school dropout is more difficult to identify, but it is an important problem on par with explicit school dropout. These children are not classified as early leavers and, as a result, are very unlikely to enjoy support actions to raise their skill level. They thus constitute that share of pupils that fuels the worrying phenomenon of implicit or hidden dispersion.
Adding up the number of explicit and implicit missing students, it is possible to estimate that total dispersion in Italy is more than 20 percent, a problem that thus affects one in five citizens.
According to the learning surveys conducted in A.S. 2020-21, the pandemic from COVID-19 may have exacerbated the problem of implicit school dropout bringing the percentage value, which stood at 7 percent in 2019, to a value of 9.5 percent in the survey year. This implies that

9.5 percent of students in Italian schools graduated from high school without the minimum skills needed (according to Invalsi standards) to enter the world of work or university.
In Italy as in most other countries, girls generally perform worse in mathematics than boys, although better in text comprehension.
The skills acquired in education vary considerably not only because of the territory of residence of the boys, but also by type of school: in both Italian and mathematics, in fact, the results of students in high schools are on average better than in technical institutes and these than in vocational ones. It is important to note that the level of skills acquired in schools in the South is worse than average, whatever the type of educational institution.
Spatial differences in the percentage of implied dispersion also grow, with the value starting from 2.6 percent for the North, reaching 8.8 percent in the Center to 14.8 percent in the South, 12.2 points higher than in the regions of Northern Italy.



Comparing the 10 Italian provinces with the lowest and highest "implicit" dispersion index, it can be seen that in the provinces where the "implicit" dispersion index is lowest, elementary school ensured that children had more full-time offerings (attended by 31.5 percent of students vs. 24.9 percent in high-dispersion provinces), more canteens (25.9 percent of schools vs. 18.8 percent), more gyms (42.4 percent vs. 29 percent). Moreover, even more significant is the incidence of the socioeconomically disadvantaged. In fact, "implicit" dispersion is significantly lower in those provinces where at least half of the elementary school pupils attend full-time and at least half of the schools have canteens (10 percentage points less dispersion than in provinces where less than 1 in 4 pupils attend full-time at primary or where less than 1 in 4 elementary school have canteens). The same positive correlation is also shown on the presence of the gymnasium (5.5 percentage points less dispersion implied in provinces where at least 50 percent of elementary school have it, compared to provinces where the gymnasium is present in less than a quarter of schools).
School dropout is not attributable to a single factor, but is the result of interactions and combinations among different elements, such as factors related to school operation, school

organization and culture, class and school composition by socioeconomic status, ethnic background, and religious orientation.
Among the various causes the studies highlight, three classes of factors:
Factors that are referable to the students or the context in which they live:
- cognitive and learning difficulties
- demotivation toward studying and school,
- sense of inadequacy with respect to the possibility of satisfactory academic achievement
- socio-econic conditions (including parents' educational qualifications, general family feeling toward school and school participation)
- geographical context,
- relationship between students and teachers,
- quality of teaching
- low expectations in the school's ability to impact students' future opportunities

Wider factors affecting schools and students such as the country's social cultural and economic system:
- the labor market
- changes in social and cultural structures
- demographic trends
- phenomena such as the spread of groga and violence

Factors related to relational difficulties:
- feelings of distrust toward school
- non-completion of schooling due to lack of adequate skills
- dropping out due to lack of acceptance of school rules (capable drop-out)
- temporary interruption of the course of study (stop-out)
- difficulty in the course of study (pushout)

Status of origin, social class, and cultural capital continue to influence the opportunity to obtain higher education degrees, although the combination of these factors has been most mitigated by improved living conditions over the past century. Socioeconomic background impacts both motivation to study and educational and occupational ambitions. Social background is also likely to guide the educational path chosen by young people.
Dropping out of school before graduation affects 22.7 percent of young people whose parents have at most a high school diploma; very low incidences of dropouts, at 5.9 percent and 2.3 percent, are found, on the other hand, for young people with parents with an upper secondary degree and parents with a tertiary degree, respectively. Similarly, if the parents are in unskilled professions or do not work, school dropouts are more frequent (about 22 percent), while they are contained when the highest profession among that of the father and mother, is highly skilled or clerical (3 percent and 9 percent, respectively).

ISTAT data
ISTAT's periodic analyses provide the most integrated and complete picture of the various dimensions of the phenomenon at the quantitative and qualitative levels. The most recent data refer to 2020 and were published in a report by the Child and Adolescent Authority (2021). The report shows that the estimated share of ELET (Early Leavers from Education and Training, that is, young people aged 18 to 24 who do not earn more than a high school diploma or a qualification of a maximum duration of 2 years) in 2020 is 13.1 percent, which is high compared to the European average (9.9 percent), but down from the previous year (13.5 percent). The incidence of dropouts has decreased significantly (it was nearly 20 percent in 2008), particularly in the

South, where, however, it is still at 16.3 percent compared to about 11 percent in the North-Center. This figure follows the positive trend of recent years but does not consider, as described in the INVALSI report, implicit dispersion. Italy ranks fourth to last in the number of Early School Leavers, with worse results only in Romania (15.6 percent), Spain (16 percent) and Malta (16.7 percent).

Italy lags behind on education compared to other EU27 countries, especially in terms of university education: just 20.1 percent of individuals aged 25-64 are reported to have obtained a tertiary degree in Italy, compared to 32.5 percent in the EU27.

Our country ranks second to last in the EU27 ranking for the share of university graduates among 30-34 year olds (27.8 percent compared to 40 percent of the European average), although progress in the last decade has been faster on average. The gap with the rest of Europe also affects women (34.3 percent of female graduates in Italy versus 46.2 percent in the EU27), who are also more likely to graduate than men (21.4 percent of female graduates in Italy, last place, versus 35.7 percent).

The pandemic-related crisis has contributed to the decrease in the employment rate of 18-24 year-olds with early dropouts-from 35.4 percent in 2019 to 33.2 percent in 2020 (versus 45.1 percent and 42.6 percent in EU27, respectively)-and to the increase in the same age group of young people with early dropouts who would like to work (from 48.1 percent to 48.9 percent in Italy and from 33.3 percent to 35.6 percent in the European average). These young people are particularly disadvantaged in the South, where the share of employed people does not go beyond 23.3 percent compared to more than 40 percent in the North-Center.

A recent Istat report highlighted the problem of home space and computer equipment that students were able to use during the Covid- 19 emergency. The reported data show strong spatial and social class differences in children's computer equipment. Before the pandemic crisis, in 2018-2019, 12.3 percent of 6-17 year olds (850,000) did not have a computer or tablet at home, and the share reached nearly one-fifth in the South. In 2019, more than one in three children in the North reported high levels of digital competence, compared with 26.5 percent in the South and 18.2 percent in insular Italy. In addition, about 41.9 percent of children in our country live in overcrowded housing.

The analysis of southern regions

Istat data: In the 2020/201 school year, available places in public and private early childhood services on the Italian territory covered 27.2 percent of children up to age 2. The gap between the Center-North and the South is wide.

- In 2021, the share of 18-24 year olds leaving the education and training system without having obtained a diploma or qualification is 12.7% (517 thousand young people) and marginally down from the previous year (14.2%).
- In the school year 2021/2022, the share of children in grade V of secondary school who did not achieve a sufficient level of literacy proficiency was 48.5 percent, stable from the previous year (48.2 percent) but still far from the pre-pandemic results (35.7 percent in the 2018/2019 school year). Inadequate math proficiency is also high, 49.9 percent on average in Italy, on the levels of the previous school year (50.3 percent) but far from the levels achieved in the pre-pandemic school year (39.3 percent in 2018/2019). Territorial and citizenship differences remain wide.
- In 2021, the share of the population aged 30-34 in Italy that has completed tertiary education is 26.8 percent, down from the previous year (27.8 percent). The share is lowest in the South (20.7 percent) and among men (25 percent).
- During 2021, 9.9 percent of individuals aged 25 and 64 had at least one educational activity in the past 4 weeks (it had been 7.1 percent in 2020 and 8.1 percent in 2019), largely recovering the loss that occurred in 2020, due to actions to counter the spread of COVID-19. Participation is increasing in all regions.

According to Save the Children's analysis, in the southern regions despite a substantial reduction that occurred in the last year particularly in Puglia (-4.3 percent) and Calabria (3.8 percent), there remain higher percentages of "missing out" at the end of education than the national average, with a peak of 19.8 percent in Campania. In addition, in Campania, Calabria and Sicily more than 60 percent of students do not reach the basic level of proficiency in Italian, while those in mathematics are disregarded by 70 percent of students in Campania, Calabria, Sicily and Sardinia.

In the case of explicit dropout, school dropout in most southern regions is well above the national average (12.7 percent), with peaks in Sicily (21.1 percent) and Apulia (17.6 percent), and significantly higher values than in the Center and North also in Campania (16.4 percent) and Calabria (14 percent). Even when examining the percentage of Neet (15-29 year olds who are out of any work, education or training pathway), which in Italy is 23.1 percent, in regions such as Sicily, Campania, Calabria and Puglia they even exceeded their working peers (3 young Neet for every 2 young people in employment).

The South and Islands also pay for greater variability between schools and between classes. What does this translate into? That skill levels are much more polarized: that is, the best/worst results are concentrated in one school rather than another or in a particular class.

The added value given by schools, teachers and virtuous teaching can lead to an improvement in the starting level of the institution, in the North as well as in the South.

Early School Leaving and Dropout in Calabria

In the present school year, 2022/2023, there are 360 state institutions in Calabria: 37.5% (equal to 134 institutions) are in the province of Cosenza, 25.6% (91) in the province of Reggio Calabria, 17.8% (64) in the province of Catanzaro, 10.2% (37) in the province of Crotone, and finally 8.9% (32) in the province of Vibo Valentia.

There are 2,992 school sites, of which 29.8 percent (amounting to 872) are preschools, 28.6 percent (836) elementary school, 16.3 percent (476) high schools, 15.7 percent (460) junior high schools and 7.7 percent comprehensive schools.

Compared to the previous school year, there was an overall decrease of 5 locations; specifically, there was a decrease in preschools (-14)2 and elementary school (-4)3 while there was an increase in high schools (+8), related to the establishment of evening courses for adult education (7)4 and a prison section in the province of Reggio Calabria.

There are 407 parish schools: 84.5 percent are preschools, 7.6 percent secondary schools, 5.7 percent elementary school, and 2.2 percent secondary schools. Compared with the previous year, there was an overall decrease of 21 locations.

Data on early school leaving show that the greatest critical issues are related to so-called "implicit dropout."

With reference to the levels of proficiency achieved by students who in the a.s. 2020/2021 attended the eighth grade, it emerges that:

50.9% of Calabrian students graduate without achieving an adequate level of proficiency in Italian while at the national level the share is 38.5%;

63.1% of Calabrian students do not achieve an adequate level of proficiency in mathematics while at the national level the share is 44.5%;

40.9% and 64.4% of Calabrian students do not reach an adequate level of proficiency in English reading and listening while in Italy it is 23.7% and 40.3% respectively.

As for the students who took the high school graduation examination in a.s. 2020/2021, it emerges that:

69.2% of Calabrian students graduate without achieving an adequate level of proficiency in Italian while at the national level the share is 48.1%;

72.7% of Calabrian students do not achieve an adequate level of proficiency in mathematics while at the national level the share is 50.2%;
69.4% and 84.0% of Calabrian students do not reach an adequate level of proficiency in English reading and listening while nationally the share is 50.1% and 62.9% respectively.
As already mentioned, several factors contribute to triggering and fueling the phenomenon of implicit school dropout including: the psychological characteristics of students, the organization of teaching and schooling, the educational background of the family, and the socio-economic conditions of the family. This last aspect in the Calabrian context has a decidedly significant weight as can be seen from the analysis carried out by the Observatory on data published by the Ministry of Economy and Finance. In particular, it was found that there are only 54 (out of 409) municipalities that have a per capita income higher than the regional average value, which for the 2020 tax year stands at 15,539 euros. There are 320 municipalities with a percentage of taxpayers with income below the regional average of more than 60 percent6.
In explicit dispersion, which refers to students who leave the school system before finishing and without a qualification, regional data are in line with what happens at the national level.
The rate of dispersion in the transition between the first and second cycle is 1.1 percent, as is found for Italy. In the case of secondary schools, the percentage of pupils who interrupt attendance without valid reasons before the end of the school year is 0.7 percent (in Italy it is 0.6 percent), while in the case of secondary schools the percentage stands at 2.9 percent, which is slightly lower than the national average value of 3.3 percent.7 The rate of pupils who interrupt attendance without valid reasons is 0.7 percent.
The demographic analysis of the school population (3-18 years old) reveals two phenomena to be carefully monitored in the coming years: overall decrease in school population and increase in foreign students.
In Calabria, young people of educational age amount to 274,982 in 2021 and represent 14.6 percent of the resident population. Compared to 2016, there was a decrease of 7.1 percent and this phenomenon affected all Calabrian provinces: Vibo Valentia - 10.6 percent (from 25,400 to 22,697), Crotone - 8.8 percent (from 29,480 to 26,885), Reggio Calabria - 7.7 percent (from 86,741 to 80,999), Catanzaro - 6.7 percent (from 53,066 to 49,485), Cosenza - 5.5 percent (from 101,421 to 95,816).
Focusing on demographic trends by age group, it emerges that this phenomenon affects all age groups, and in particular for the 3-5 years and 6-10 years age groups there was a change of -8.1%; for the 11-14 years age group the decrease was 5.6%, and for the 15-18 years age group -6.9%.
Forecasts for the short term are not optimistic as a decrease in the cohorts of the population that will attend school in the years to come is expected, with consequences for both school sizing and the services to be designed and delivered by educational institutions.

Between implicit and explicit dropouts, Calabria reaches a level of about 20 percent. In addition to the dropout rate, there is also the percentage of those who, despite completing school, do not achieve adequate levels of basic skills. The factors influencing these results are many, but many are related to social and economic problems in the area.
In Calabria, 42.4 percent of children live in relative poverty, ranking first in this ranking. In addition, the 2020 lockdown and the use of digital education have complicated matters: it was estimated that 12.3 percent of minors in Calabria did not own a pc or tablet at home, making it impossible to access education
School dropout is definitely an obstacle to economic growth and employment. It increases poverty and exclusion and slows down productivity and competitiveness. In fact, young people who drop out of education and training early will lack skills and qualifications and will be at greater risk of unemployment, social exclusion and poverty.

The territorial gap between southern Italy and the rest of the country is also a gap in educational opportunities. As seen above, Calabria has the highest rate of inadequate literacy skills and the highest percentage of NEETs in the country (accounting for 36.3 percent in the 15-29 age group). These data are particularly severe in the region's most problematic areas, such as the vast Locride district located on the Ionian side of the metropolitan city of Reggio Calabria. For example, in the most populous municipality in the district, Siderno, in the Invalsi 2021 survey carried out in the city's secondary schools, 88 percent of high school seniors (grade 13) do not achieve adequate minimum skills in Italian (below level 3). In English the figure is tragic, only 2.19% have adequate minimum skills, while in mathematics (in the same grade) 70% of pupils do not achieve adequate skills. Similar critical issues are found in inland and more isolated centers, which bring out the correlation between the weakness of the culture of legality and the high rate of both explicit and implicit dropout. There is also a serious problem related to the so-called learning environments, in fact many Calabrian schools are below acceptable standards and are in absolutely depressing conditions with dilapidated classrooms and spaces.
In our school, IIS MAZZONE of Roccella Ionica articulated in Liceo Scientifico, Liceo Linguistico, Istituto Tecnico Industriale (having the addresses of Meccanica e Meccatronica, Elettrotecnica, Informatica, Chimica, Trasporti e Logistica) the share of students admitted to the following years is in line with national references; on the other hand, dropouts and outgoing transfers are lower than national references.
The school's score in INVALSI tests is in line with that of schools with similar socio-economic and cultural backgrounds. In some high school classes, the results achieved in both Italian and mathematics are equal to or higher than the regional average. In the Institute, there is some variability in results between classes due in part to differences in subject areas, and there are cases of individual classes deviating positively or negatively from the school average. The share of students placed in the lowest level is in line with the regional average.

Prevention and containment of Early School Leaving and Dropout

Knowing the characteristics and causes of school dropout is important in order to initiate counteracting actions that also include prevention paths such as:
- Setting up learning conditions commensurate with the characteristics of learners
- Choosing the most appropriate strategies to motivate students
- Promoting both disciplinary learning and interpersonal skills with classroom organization and management methods deemed appropriate to the context

INVALSI data not only capture the final data on dropout, but also allow early diagnosis of dropout so that reinforcement intervention is possible during the educational process.
In fact, the factors that contribute to total school dropout begin to manifest themselves as early as the primary cycle, although they are rather difficult to identify and quantify.
The concept of implicit school dropout facilitates early detection of the dropout phenomenon, as early as the primary and secondary school levels
Standardized learning surveys can therefore provide very important indications and facilitate the adoption of measures to prevent school dropout.
Early help, which intervenes on the problem from its onset, can have a higher probability of success and lead within a few years to a significant reduction of this phenomenon in Italian schools.
To combat or contain as much as possible the phenomena of early school leaving, almost all education systems have tried to develop more or less targeted strategies, including measures and opportunities of various kinds. The same international agencies have been insisting on this for years now, especially with reference to those countries that show a certain amount of delay in this matter. Among these measures is certainly the practice of reception, consisting of a set of initiatives (of information, first orientation, socialization) taken care of by educational

institutions and designed to facilitate the insertion of children or young people in educational facilities. The practice of reception is recommended especially at the time of the start of a course of study or the transition from one grade to another in the educational process. it is even necessary for the insertion of pupils from other backgrounds and countries and, in the case of children of immigrants, with a cultural background different from that of other pupils.
Another significant measure, suggested by contemporary didactics but not easy to generalize, is the individualization or personalization of teaching, which can be defined, however, only within the framework of a very flexible and technically qualified educational planning.
Another institute that should help contain the dispersive phenomena is that of facilitating transitions from one channel to another of secondary education courses through special non-penalizing lanes.
The institution of tutoring is also largely conceived from the perspective of facilitating the educational path of pupils, putting in place different aids according to the cases and even going so far as to involve the families of struggling pupils in the process.
In addition, good educational practice can be a potential pull for other struggling institutions and trigger broader contextual transformation in the same geographic area, for example, by multiplying occasions and opportunities to publicize their results and ways of working.
This principle was recently emphasized in the final document of the Education Forum, which was held in Camogli on February 1-2, 2020. Among the steps suggested for combating educational poverty, a prominent role is given to the recognition and enhancement of existing educational practices and concrete support for these good practices with appropriate policy strategies.

Useful websites

https://www.openpolis.it/labbandono-scolastico-nel-2020/

https://www.centrostudimanzoni.com/blog/aiuti-allo-studio/fenomeno-abbandono-scolastico-in-italia/109.html

https://www.savethechildren.it/press/scuola-l%E2%80%99aumento-della-povert%C3%A0-tra-i-minori-mette-rischio-i-percorsi-educativi-un-milione

https://www.miur.gov.it/web/guest/news?p_p_id=1_WAR_miurmulticategoriesnavigator100SNAPSHOT&p_p_lifecycle=1&p_p_state=normal&p_p_mode=view&p_r_p_categoryIds=38244,314071

https://www.istat.it/it/files/2021/10/REPORT-LIVELLI-DI-ISTRUZIONE-2020.pdf

https://www.istat.it/it/files//2021/07/Istat-Audizione-Dispersione-scolastica_18-giugno-2021.pdf

https://www.invalsiopen.it/perche-dispersione-scolastica/

https://www.regione.calabria.it/website/portalmedia/decreti/2022-10/DGR-n.-499_2022...pdf

LITHUANIA

Introduction

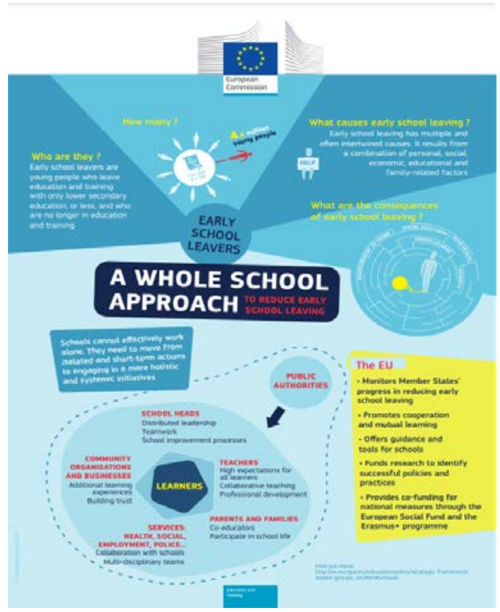
While the international context is improving the assessment of Lithuanian education and the confidence of the Lithuanian population in education is growing, the share of the Lithuanian population with tertiary education and the extent of lifelong learning is increasing, tertiary graduates are more competitive on the labour market than those with lower levels of education, even in pandemic conditions, and the gap between education and employment has narrowed. The post-pandemic period has led to a deterioration in the psychological well-being of Lithuanian society, with the mental health of young people being a particular concern. Not all schools in the country are implementing long-term programs to prevent violence, bullying and to promote healthy lifestyles, as provided for in the Law on Education. While general education pupils' achievement indicators show stability or improvement, the problem of the achievement gap between urban and rural areas persists, with pupils in urban schools performing better than those in rural areas. Although the rapid changes in modern life encourage continuous learning and development, the learning path is not always successful and smooth. Some learners drop out, i.e., although they do not complete their education program, they do not continue their education in the following academic year.

The nature of the problem of early school leaving

According to the OECD, young people aged 15-24 who are not in education or employment accounted for an average of 22.5% of all people in this age group in 2020. These young people were not in education and were inactive in the labor market, which means that they are at risk of social exclusion and poverty. The highest share of inactive young people aged 15-24 in OECD countries in 2020 was in Colombia (57.8%) and the lowest in the Czech Republic (12%).

School drop-out is associated with unemployment, social exclusion, poverty, and poor health. Some young people drop out of school and leave early for a variety of reasons: personal or family problems, learning difficulties or a precarious socio-economic situation. The quality of the education system, the general atmosphere at school and the relationship between teachers and pupils are also important.

As the reasons why children do not complete secondary education are often complex, policies to reduce the number of early school leavers need to address a wide range of issues and include education and social policies, youth work and health-related aspects. Some of these challenges are outlined in the infographic provided by the Commission.



State strategy for education 2013-2022, objectives and directions for educational change (tasks)

The State Strategy for the Progress of the State of Lithuania "Lithuania 2030", approved by the Resolution of the Seimas of the Republic of Lithuania No. XI-2015 of 15 May 2012 (Žin, 2012, No. 61), aims to bring together the global trends in educational philosophy, policy and practice, the latest data on the state of education in Lithuania and the European Union, and to allocate financial, material, and intellectual resources to it. The following education objectives, as set out in the State Progress Strategy "Lithuania 2030" and the Law on Education of the Republic of Lithuania, have been considered in the development of the Strategy.

The main strategic goal is to make Lithuanian education a sustainable basis for the prosperity of the state, to educate a driven and independent person who will build his/her own, Lithuania's and the world's future in a responsible and solidarity-based manner.

The vision of education in Lithuania is that every child, young person and adult in Lithuania seeks and easily finds a place to learn, that the country's education system is composed of state, municipal and non-state educational institutions, which are continuously improving, collaborating with each other and with partners who have authority in society, and are in constant discussion about the development of education in the country, the success of the Lithuanian state and its people, the development of culture and society, the economy, and the sustainable development of cities and rural areas.

One of the four main objectives of the Education Strategy is to ensure that pupils, students and young people have the best possible opportunities to develop their individual abilities and to meet their special educational and learning needs, while ensuring access to education and equality of opportunity, and the inclusiveness of children and young people (hereafter referred to as "the third objective"). Provide effective educational and psychological support for pupils with learning difficulties.

Justification for the third objective of the strategy: less than 9% of young people in Lithuania drop out of school early (we are among the top 10 EU Member States, http://epp.eurostat.ec.europa.eu/; http://www.svis .smm.lt; http://www. .stat.gov.lt), but there is a worrying number of out-of-school children in Lithuania. Some parents and pupils are dissatisfied with the prevailing style of education in school and want more alternative education focused on individual development and personal growth. This is the case for both rural and urban children, children at risk of social exclusion, migrants, children with special educational needs, who find it difficult to integrate into the mainstream and are lagging many social processes. The formal content of education alone does not provide sufficient opportunities for self-expression, leadership, character and identity development, national identity, understanding of the role of the culture-maker, creative freedom and creativity, knowledge of nature and entrepreneurship. The need for cultural self-expression is currently putting enormous pressure on formal education, which cannot meet all the needs and expectations without running the risk of formal content overload.

Even gifted children sometimes fail to find an acceptable form of learning. This raises problems of inclusion in education and alternative learning opportunities, especially for social, personal and cultural development. There is little or no involvement of museums, libraries, other cultural and artistic institutions and other potential providers of non-formal education in non-formal education, and insufficient attention is paid to the pedagogical qualifications of existing and potential non-formal education providers. Institutional pre-school education is not sufficiently accessible to children. Informal forms of academic interaction and learning and infrastructure (study campuses) are underdeveloped.

The smaller number of mainstream schools in rural areas makes access to basic and non-formal education more difficult for the rural population, and the financial and time costs are higher.

The following actions/objectives are foreseen to achieve the third objective of the strategy:

- Expand learning choices and opportunities through a "cash-for-pupil" model of financing education institutions, taking into account national regional policy, public planning and public procurement. Develop financial mechanisms to increase regional coverage of education. Strengthen the activities of the State Fund for Higher Education by providing loans for studies.

- Enriching the learning and practical application environment in schools, expanding the range and diversity of non-formal education activities in all schools, in particular opportunities for cultural self-expression, leadership, creativity, entrepreneurship, vocational skills, support for volunteering initiatives, together with an ongoing dialogue on development priorities. Social, emotional, sexual, and intercultural education. Introduce systemic changes in schools to reduce bullying, human trafficking and violence, alcohol and tobacco use, to ensure the psychological safety of the school community;

- Ensure that access to education is prioritized for social exclusion, victims of trafficking and groups at risk, and those with special educational needs, in order to strike a balance between overcoming social exclusion and developing the gifted. Establish an effective system of social support for disadvantaged participants in the education system. Strengthen the role of the Ministry of Education and Science and municipal administrations in coordinating special education and provide quality methodological support to special education specialists. Implement the restructuring of the network of rural and minority language schools, taking into account the interests of communities, especially children, and in line with the principal of school efficiency and reducing social exclusion. Ensure the strengthening of Lithuania's national and civic identity, the quality of teaching and education in the Lithuanian language and the mother tongue of national minorities, and the preservation and continuity of Lithuanian culture.

- develop the integrity and complementarity of formal and non-formal education and introduce open and flexible learning methods. Provide opportunities for independent learning where appropriate

- Ensure the development of Lithuanian identity and culture.

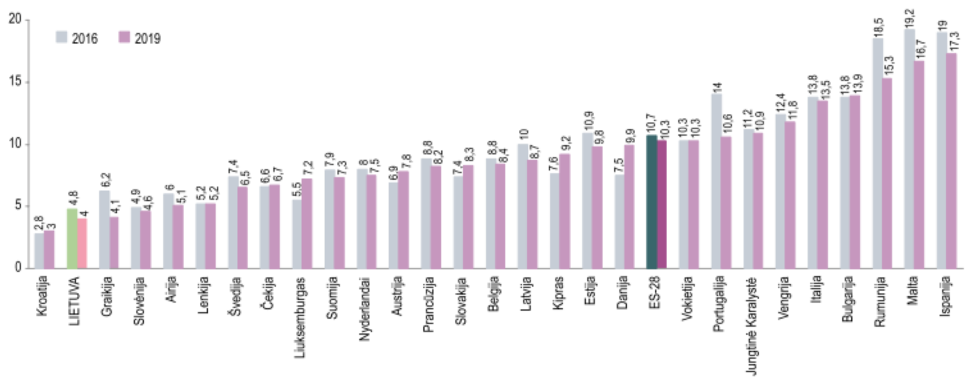
Stopping school

European level

Compared to EU countries, the share of early school leavers (i.e. 18-24 year-olds who have not completed upper-secondary education and are not in further education) in Lithuania in 2019 was low (4%) and decreasing. Lithuania was the second lowest among the 28 EU countries in this indicator. Only Croatia was ahead of Lithuania. The share of early school leavers for both girls and boys has been declining, but the share of the latter is almost twice as high (5.1% and 2.8% respectively in 2019). In urban areas, the share fell from 3.2% to 2.7% in 2019 compared to 2016, while in rural areas it fell from 7.8% to 6.1%, but remained more than twice as high. In the same year, the shares of female and male early leavers were 2.3% and 3.2% in urban areas, 1.5 percentage points and 5 percentage points lower than in rural areas.

Lithuania has the second lowest early school leaving rate among EU countries

Proportion of 18-24 year-olds who have not completed upper-secondary education and are not in further education (%) in EU countries



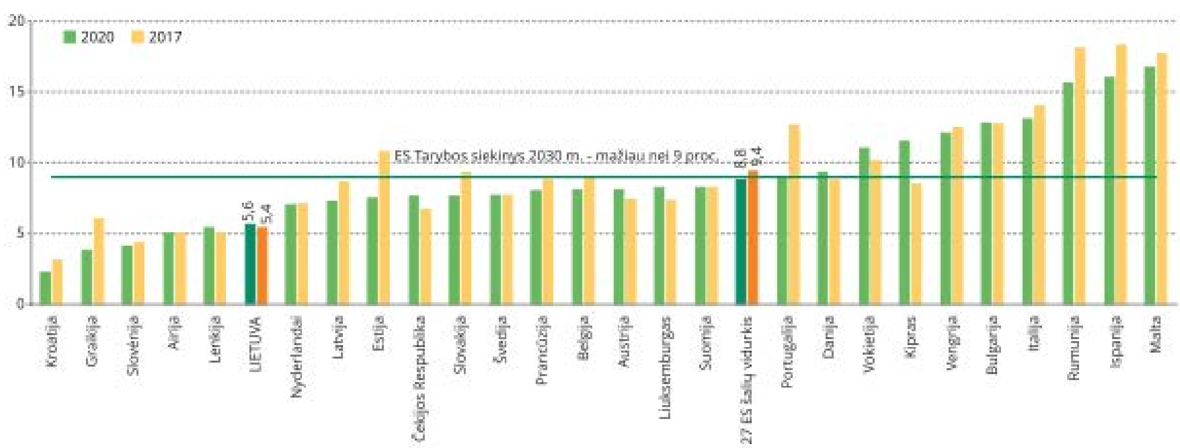
Data source: Eurostat

In 2021, Lithuania also had a relatively low number of early school leavers. According to Eurostat, the EU average was 9.7%, while Lithuania's rate was 5.4%. Only four EU countries had a lower rate than Lithuania: Croatia, Slovenia, Greece, and Ireland (2.4%-3.3%). Although the number of early school leavers in Lithuania is low, the educational and working careers of young people in Lithuania are not very successful in international comparison. In 2020, the share of 20-24 year old's not in education or employment in Lithuania was higher than the OECD average (17.4% and 15.8%, respectively) and many European countries.

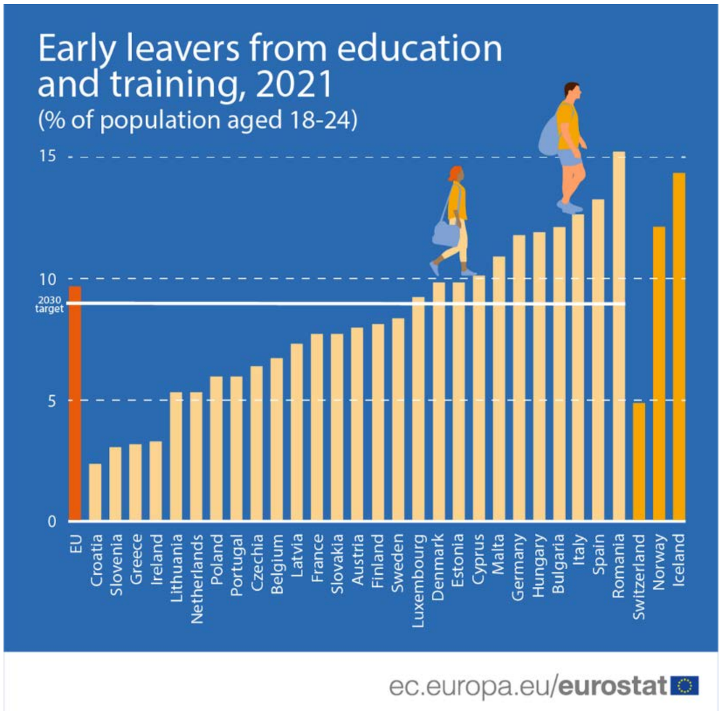
Lithuania has the sixth lowest early school leaving rate in the EU in 2020

Proportion of 18-24 year-olds who have not completed upper-secondary education and are not in further education (%)

in EU countries

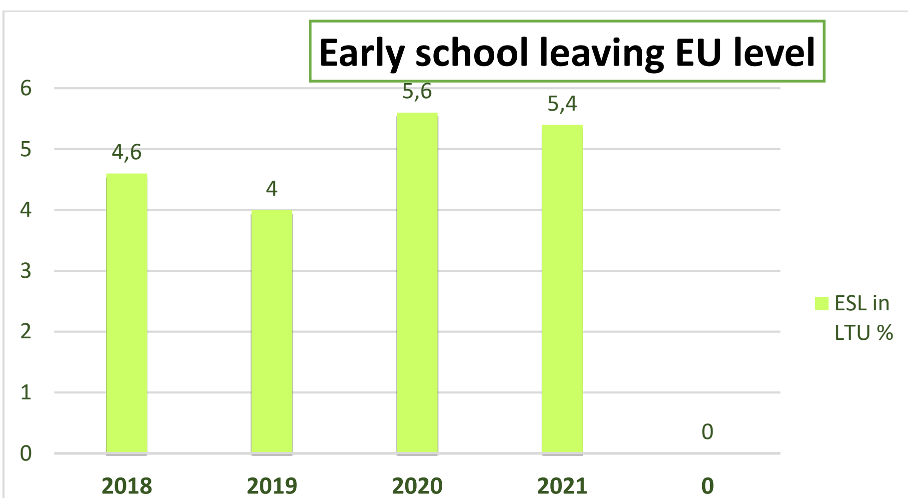


Data source: Eurostat



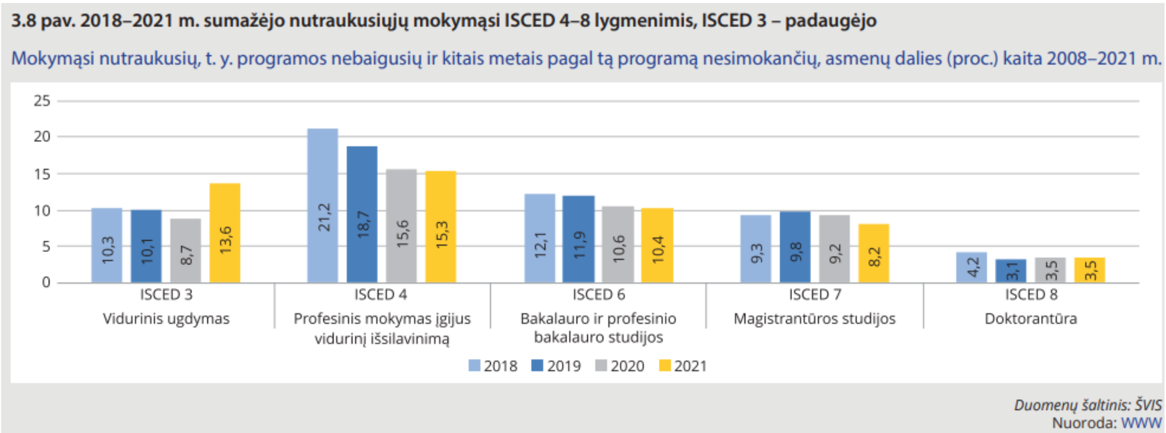
European level

	2018	2019	2020	2021
ESL %	4,8	4,0	5,6	5,4
Vieta EU	5	2	6	6

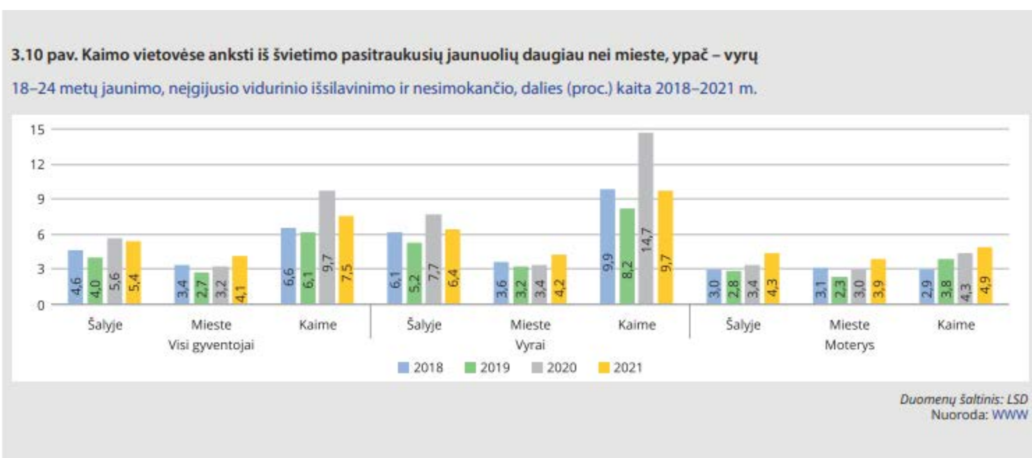


National level

In 2021, the most frequent drop-out rate was for ISCED level 4 vocational education and training (15.3%) and the least frequent was for doctoral students (ISCED level 8; 3.5%). Between 2018 and 2021, the drop-out rate has decreased, except for the level of secondary education (ISCED 3), which includes general education and vocational training programs at this level. Further analysis is needed to identify the reasons for the increase in drop-out rates (not excluding misreporting).



Women are less likely than men to drop out of school, except at ISCED level 4. Those aged 18-24 who have not completed upper secondary education and are not in education are considered early leavers. According to LSD data, the share of such young people in Lithuania in 2021 is 5.4%, slightly higher than in 2018 (4.6%). The highest number of early school leavers in 2020 is due to a significant increase in the proportion of males leaving education in rural areas, which dropped again in 2021. In rural areas, the share of early school leavers is higher than in urban areas (7.5% and 4.1% respectively in 2021), while the share of men than women is higher (6.4% and 4.3% respectively), but there is an upward trend in the female group from 2018 to 2021.



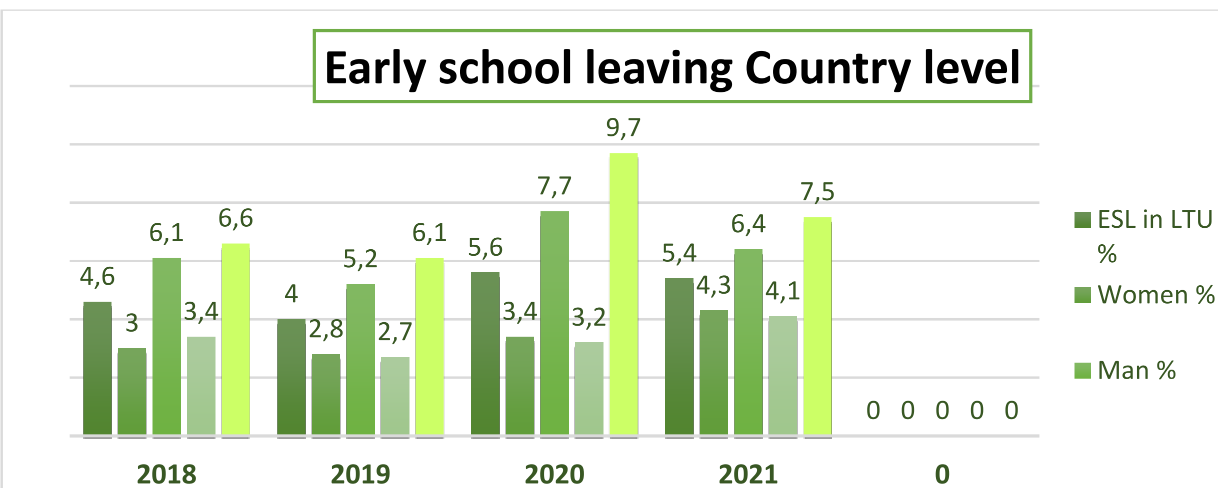
Young people not in education or employment. Children out of school

According to the OSP RDB, the majority of out-of-school children have moved abroad and are likely to continue their education there (13 075 out of 16 376 out-of-school children in 2021).

Other pupils are absent for various unspecified social, psychological, and other reasons. In 2018 there were 5 219 such children, in 2019 there are 9 022, but this number drops to 4 385 in 2020 and 3 450 in 2021. The NIS also collects data on out-of-school children aged 7-16 by other classifications of reasons, but the data confirms that the number and percentage of out-of-school pupils of this age is decreasing: 6.2% of children aged 7-16 were out of school in 2018 and 5.1% in 2021. Most of them were absent because they went abroad (86% of those out of school in 2021). The NICS data show that the number of children who are not enrolled because they were not compulsorily enrolled for various reasons is decreasing, as well as the number of children who are not enrolled by their parents. However, the number of children out of school due to disability is showing little change (32 in 2021), possibly reflecting the fact that some children with severe conditions are not being able to access either mainstream or special education due to health problems.

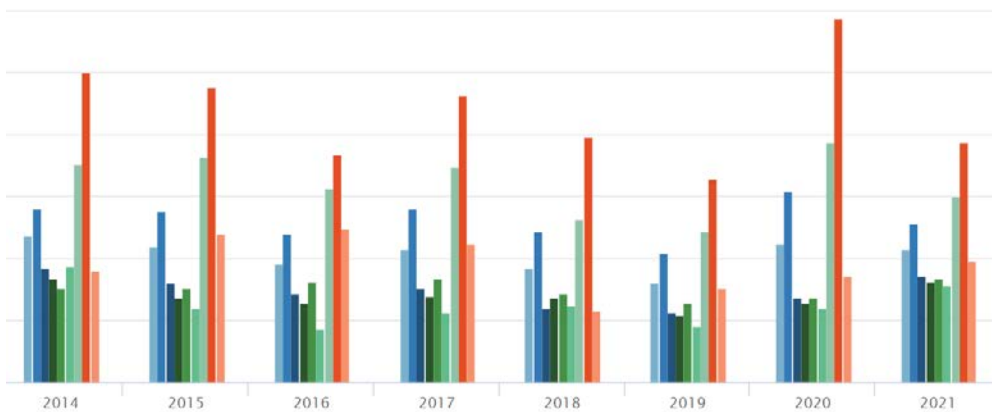
National level

	2018	2019	2020	2021
General ESL %	4,6	4,0	5,6	5,4
Man %	6,1	5,2	7,7	6,4
Women's %	3,0	2,8	3,4	4,3
In the countryside %	6,6	6,1	9,7	7,5
In cities %	3,4	2,7	3,2	4,1



Proportion of young people aged 18-24 who have not completed upper secondary education and are not in further education

Proportion of young people aged 18-24 who have not completed upper secondary education and are not in further education.



Kaunas region level

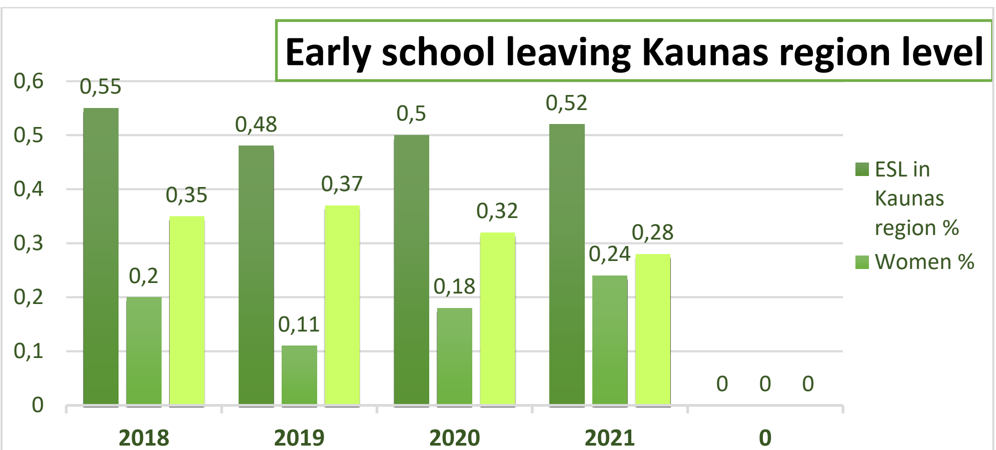
When analyzing the continuation of education data for municipalities, there are significant regional differences: the highest share of graduates (more than two-fifths) who completed secondary education and continued their education at university in the same year was in the municipalities of Lithuania's largest cities, while in municipalities in the rest of the country it was around one-third, and the drop-out rate in 2019 decreased at all levels of education, compared with 2018. The highest share remained in vocational education and training institutions. The drop in the drop-out rate of 17–24-year-olds in 2019 started to rise again in 2020. This is attributed to the emergence of the Covid-19 pandemic and the start of distance learning, which has had severe consequences on learning attainment and outcomes. In the post-pandemic period, at the end of 2021 and the beginning of 2022, this situation is improving, leading to a decrease in the number of young people leaving the education system.

It is observed that a higher share of dropouts comes from small vocational training institutions with less than 300 students. The main reasons for leaving VET are absenteeism (18%), going abroad (13%), getting a job (12%), and lack of progress (11.2%). However, for about 30% of VET pupils, the reasons for leaving education are not known precisely, as no detailed data have been collected. The share of male early leavers (7.7%) was about twice as high as that of female early leavers (3.4%), while the share of rural leavers (9.7%) was three times higher than that of urban leavers (3.2%). Men living in rural areas accounted for a particularly high proportion (14.7%), while women accounted for 4.3%.

Kaunas municipality maintains a relatively high level of young people completing secondary education and continuing their education, so the national dropout rate, observed from 2018 (0.55%) to mid-2022 (0.52%), is changing slightly and is in line with the general trends of the major municipalities. This does not mean, of course, that the problem does not exist in Kaunas County, and therefore the municipalities of the city and the county are contributing to its reduction in various possible ways.

Kaunas region level

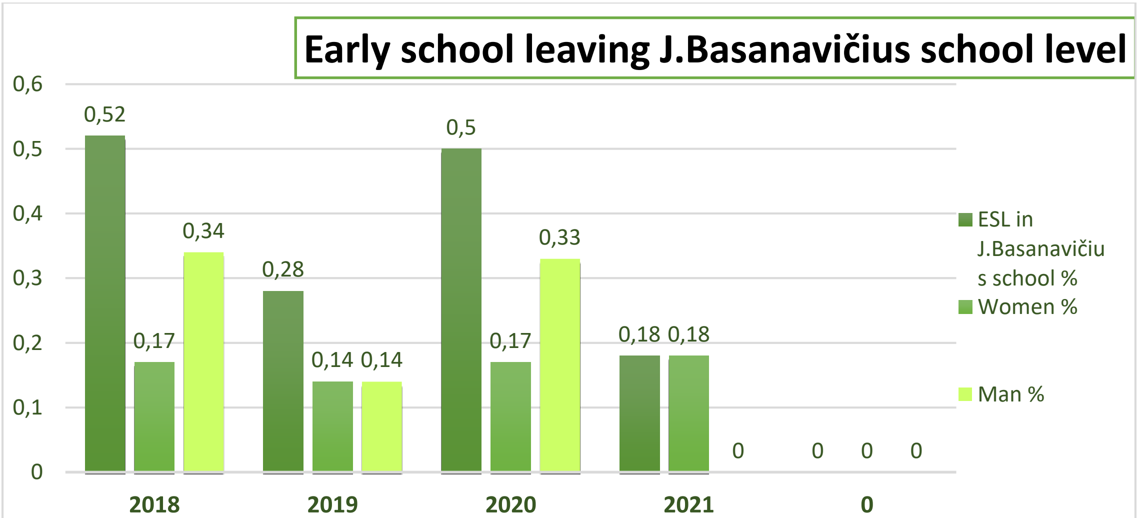
	2018	2019	2020	2021
General ESL %	0,55	0,48	0,5	0,52
Man %	0,35	0,37	0,32	0,28
Women's %	0,2	0,11	0,18	0,24



KAUNAS JONAS BASANAVIČIUS GYMNASIUM

Our school level

	2018	2019	2020	2021
General ESL %	0,52	0,28	0,5	0,18
MALE	0,34	0,14	0,33	0
FEMALE	0,18	0,14	0,17	0,18



National strategy. Education and training

Preventing early leaving from education and training (ELT)

National level

The National Education Strategy 2013-2022 sets a national target of keeping the ELT rate below 8% by 2022. There is a gender gap, with a 6.9% ELL rate for males and 4% for females. Early school leaving is not formally defined, but other similar concepts are used:
a) An 'out-of-school child' is a child under 16 years of age who is not registered in the school register.
(b) 'absent child' means a child who is registered as a pupil but who has missed more than half of the lessons in the compulsory curriculum in a month without good reason.
Early school leavers aged 18-24 years with lower secondary education or less and who have been absent from school for 4 weeks. Those who have started vocational training but have not completed the qualification are considered to be non-completers.

Lithuania has developed a national policy to address the challenges of AI. Since 2005, the Law on Education has obliged municipalities to create an optimal school network. This required the preparation and coordination of initial plans in all 60 municipalities, and the school network has been reorganized, with the total number of municipal schools decreasing from 1,429 to 1,107 in the 2005-2015 reform, with almost 700 buses purchased between 2000 and 2014. The aim was not only to better allocate resources, but also to improve the quality of teaching, which leads to better motivation for pupils to attend school.

The main measures and policies related to early school leaving are increasing the number of children up to 4 years of age, possible compulsory attendance of ECEC for children at social risk, and ensuring quality ECEC through the Kindergarten and Preschool Education Project (2012-2015) (Development of Early Childhood and Preschool Education). This project is complemented by the "Promoting Cohesion" program (2007-2013), which aims to:

(a) invest in pre-school education by updating the content and improving school facilities.

b) create equal opportunities for young children in rural areas through the creation of "Universal Multifunctional centers in Rural Areas" (Universal Multifunctional Centre’s in Rural Areas) for educational and social services in the surrounding areas;

Lithuania has developed early warning systems to identify and respond to early signs of AI. Pupils who have missed more than half of their compulsory curriculum for more than one month are registered in the National Information System on Child Absenteeism and Truancy. This data is then transferred to information systems of other bodies such as social welfare, home affairs or health. An electronic school register has been introduced for general education and vocational training schools. This allows parents to see updates on their children's achievements and progress, to communicate directly with teachers and to participate in forums on various issues. Some electronic diaries allow schools to send an SMS or email to inform parents if a pupil is absent or late for school.

Another measure is the Youth Schools, which target students aged 12-16 who lack both motivations to learn and social skills, and who have learning difficulties. They engage in practical activities related to the basic education curriculum while receiving social rehabilitation. The Youth House is for students aged 12-17 who have completed a course of treatment and rehabilitation for addiction to psychotropic substances and alcohol, as well as for those who have behavioral and emotional disorders and need to improve their mental well-being and their motivation for learning, linked to the basic curriculum.

The following measures also apply:

1) Supporting underachievers with individual learning plans and educational support for pupils with special educational needs.

2) providing linguistic support for children with different mother tongues. In some schools, teaching is also provided in the languages of national minorities.

3) setting up procedures for identifying groups at risk of early withdrawal, involving municipalities, school staff, parents and, where appropriate, the Child Welfare Commission.

4) setting up a national information system on truancy and absenteeism (the Information System on Truant Children and Truant Pupils) as an early warning system for pupils at risk of leaving school early.

5) networking with parents and other actors outside the school, through projects such as Harmonious Family and Sustainable School Community - Lithuania's Future (Harmonious Family and Sustainable School Community - "Lithuania's Future"), to promote active parental involvement in educational activities;

6) Identifying school drop-outs and helping them to return to education in so-called "Youth Schools", which offer one or two years of education to students with learning disabilities or social problems. The course can lead to a return to mainstream education and training; 7) the "Confidence in yourself" project, which aims to increase students' motivation to return to education or employment. The target groups are 16–25-year-olds with no qualifications, not in employment, education or training, and not participating in the active labor market. Under 21 years of age are returned to education. The institution responsible for the preparation and implementation of the project is the Lithuanian Employment Service under the Ministry of Social Security and Labor.

Other institutions, such as the Department of Youth Affairs, 10 regional public employment services and 11 NGOs are also involved.

Specific measures targeting at-risk groups are aimed at students from disadvantaged, migrant and minority/ Roma backgrounds. The Minister of Culture of the Republic of Lithuania approved the "Action Plan for the Integration of Roma into Lithuanian Society 2012-2014". Its aim is to promote Roma participation in society, reduce social exclusion, raise awareness among the Roma community and make society more tolerant of Roma and their culture.

Vocational teachers are trained on how to work with potential early leavers. Most VET providers have set up attendance monitoring systems and action plans to improve attendance. Since 2011, most VET providers have set up Child Welfare Commissions (Child Welfare Commission), which include social educators working with potential drop-outs, their families and teachers to reduce the number of early leavers.

Other measures include projects aimed at reducing ACEs by improving transitions between general education and different vocational pathways or between different types of vocational programs. For example, the project "Alternative Education in the Education System" aimed to identify people who had left education and training early and help them to re-enter the system. The project also aimed to enable more pupils to complete their basic education and to increase the number of pupils who continue their education or training beyond upper secondary education. -19, Phase II: Deeper differentiation and personalization of learning to ensure the quality of education demanded by today's world of work". These projects aimed to provide 14-19 year old's with a broader range of opportunities to individualize and differentiate the content of their education, making it more attractive, and adapting it to the needs of the labor market through the development of vocational competences.

Tackling AAL through non-formal and informal learning and quality youth work

Lithuania has policies and instruments in place to enrich learning experiences through extra-curricular activities. These measures are also reported to have a positive impact on early school leaving. In Lithuania, initiatives to combat early school leaving allow schools to implement activities and programs that respond to the current needs of students, such as cultural, artistic, environmental and health education programs, intercultural education, etc.

Cross-sectoral coordination and monitoring of ECCE interventions

Employment, youth, social, family, justice, health, and housing policies are involved in early exit cooperation, but cooperation mechanisms are not yet in place. Multi-agency partnerships at local/institutional level involve school leaders, teachers, guidance specialists, psychologists, social workers, therapists and speech and language specialists. Schools are legally obliged to have a School Child Welfare Commission, in which the cooperation of each professional is regulated by law; however, specific mechanisms for cooperation between the different policy areas have not yet been established.

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04

SWOT analysis about STEM and Gamification

4.1. E.U. LEVEL

1. Strengths

Projects for didactic innovation

In recent years, many initiatives have been brought to promote the teaching and dissemination of STEM disciplines and stimulating students through a more intuitive and dynamic approach in order to break down the resistance that still persists today against these disciplines. Among these, the INQUIRE, Mind the Gap and PRIMAS projects can be highlighted. There have been and there are also seversal initiatives aimed at teachers and professionals operators throughout the EU territory, which have been implemented over the last few years to promote adequate training in these professional figures that is up to the challenge of relaunching the image and the teaching of STEM disciplines, sharing the good practices experienced by teachers and operators from different European countries:

- A specific mention deserves the project **Scientix**[1], funded by the European Commission and which aims to support collaboration at European level among teachers of STEM disciplines (science, technology, engineering and mathematics), researchers, politicians and other professionals in various capacities close to the topic of STEM education. The project, born in 2009 on the initiative of the European Commission, was carried out in various phases, financed by the Horizon 2020 project and coordinated by European Schoolnet, a consortium based in Brussels which brings together thirty ministries of education;

- The project **STELLA** (Science Teaching in a Lifelong Learning Approach) aims to offer support to operators involved in the world of education and teaching of scientific and technical disciplines, promoting and adopting innovative practices in the field of science education in schools of all levels in such a way as to encourage teaching of sciences in all schools in Europe and consequently encourage among young people, especially women, the choice to devote themselves to the scientific professions in the continuation of their studies;

- the **GRID** (Growing Interest in the Development of Teaching Science) is a project funded within the EU Socrates programme. Its main objective is to create a useful network and database for sharing and exchanging good practices in the field of science education in Europe;

- The projects co-financed by the Erasmus+ program are also very important, such as the **AR4STEAM**[2], the aim of which is to make young students aware of the importance of the STE(A)M disciplines and of the job opportunities that these disciplines can offer, through the promotion of learning based on immersive technologies and gamification in secondary schools. The project also aims to disseminate the ideal of effective STE(A)M discipline teachers;

[1] www.scientix.eu

[2] http://www.ar4steam.eu

- the project **NEWTON**[3] funded by the EU Horizon 2020 program has tried to renew the teaching method of STEM subjects and spread a learning approach focused on a greater protagonism of the students. To do this, the project has created a large-scale European platform NEWTELP, a virtual environment in which it is possible to share ideas and materials related to teaching methods and in which a key role is played by the practice of Gamification.

The digital education action plan.

On the other hand, the renewal of the teaching of the STEM disciplines in view of the role that these will acquire in the Europe of the future requires a concrete effort to support the education systems in the transition towards an education model that opens up more and more effectively to the digital, also taking advantage of the experience gained in the era of the pandemic and bringing together the skills acquired by the individual national systems with a view to supranational sharing.
To achieve this ambitious goal, the European Commission has re-proposed the instrument of the **Digital Education Action Plan** (2021-2027)[4], a renewed political initiative of the European Union (EU) which builds on the first plan for the period 2018-2020, which pursued the following priority objectives:

- improve the use of digital technology for teaching and learning.
- develop digital skills and abilities.
- improve education through better data analysis and forecasting.

The plan aims to achieve an optimization of the education and training systems of the Member States and their progressive adaptation to the challenges posed by the digital society.
In particular, the digital education action plan has developed from the experience gained during the COVID-19 pandemic which has in many cases highlighted the need to modernize educational institutions. The plan aims to intensify comparison and cooperation between the member countries of the Union in the field of digital education to encourage the digitization of teaching methods and the diffusion of the technologies necessary for this purpose.
Specifically, there are two sectors in which the action plan identifies two priority sectors:

1. Fostering the development of a high-performing digital education ecosystem.

2. Enhancing digital skills and competencies for the digital transformation.

The goal is to create a favorable environment in terms of digital availability and accessibility and in which personnel are in possession of the necessary familiarity with digital tools and technologies, so as to make digital literacy ever more widespread and effective, allowing at the same time to generate an increase also in the number of specialists in the sector.
The digital education action plan proposes the following 13 actions for the period 2021-2027 functional to the achievement of the two objectives indicated above:

Priority 1: Promote the development of a highly effective digital education ecosystem.

[3] www.newtonproject.eu. See also: T. LYNCH, J. PLAYFOOT, C. DE NICOLA, G. GUARINO, F. DI SALVADORE, I. GHERGULESCU, *Gamification Elements in STEM Subjects - Lessons Learned from NEWTON Project*, Ireland International Conference on Education, 2018

[4] https://education.ec.europa.eu/focus-topics/digital-education/action-plan.

- Action 1: Structured dialogue with Member States on enabling factors for successful digital education.
- Action 2: Council Recommendation on blended learning approaches for high-quality and inclusive primary and secondary education..
- Action 3: European Digital Education Content Framework.
- Action 4: Connectivity and digital equipment for education and training.
- Action 5: Digital transformation plans for education and training institutions.
- Action 6: Ethical guidelines on the use of Artificial intelligence in teaching and learning for educators.

Priority 2: Improving digital skills and abilities for digital transformation

- Action 7: Common guidelines for teachers and educators to foster digital literacy and tackle disinformation through education and training.
- Action 8: Updating the European Digital Competence Framework to include AI and data-related skills.
- Action 9: European Digital Skills Certificate (EDSC).
- Action 10: Proposal for a Council recommendation on Improving the provision of digital skills in education and training.
- Action 11: Cross-national collection of data and an EU-level target on student digital skills.
- Action 12: Digital Opportunities Traineeships.
- Action 13: Women's participation in STEM.

The implementation through the actions above of an efficient digital education ecosystem in which the digital skills and abilities of teachers can find space and improve represents the fundamental prerequisite for introducing methodological innovations and experiments into daily teaching practice that can maximize the potential offered by new technologies, such as Gamification for example.

Weaknesses

According to the most recent statistics, European students who in recent years have chosen to undertake and have managed to complete a university education path in a STEM discipline are a minority. In 2019, on average, in EU countries, graduates in these disciplines accounted for around a quarter of the total number of graduates, to be exact an average of 26%, with peaks of 36.8% in Germany.

Within this overall picture, it should be underlined that the distribution of preferences with respect to the various STEM disciplines is by no means uniform: if in fact, in general, the engineering disciplines are those which meet the greatest favor among students who at the end of school continue their university studies, the natural sciences and above all the ICT disciplines are much less popular. There are many reasons for this phenomenon, but certainly not a secondary role is constituted by the perception that students continue to have of these disciplines during and at the end of their school career. STEM disciplines are in fact considered more difficult disciplines than others and therefore there is the perception that a university education path dedicated to these could be longer and more expensive.

On the other hand, the moment of choosing a university is often not adequately supported and many students do not even have an adequate vision of what are the real job prospects that a given course of study can offer them. In some cases there is also a lack of adequate support from educational

institutions and teachers whose absence is compensated by the decisive role exercised in many cases by families and friends, with the consequence that rather than being based on real information and data, the perception of students is the result of the opinion that other people, not necessarily qualified, have about these disciplines and their marketability on the labor market.
As far as school is concerned, it is necessary to observe that even if in many cases a good number of students manage in one way or another to grasp the connection that exists between the STEM disciplines and their concrete effects in everyday life and, moreover, many of them show the desire to deepen the study of STEM subjects and in some cases also to continue to do so in their university career, there are some factors that lead us to reflect:

- Even when it is possible to arouse in students a sincere interest in topics related to STEM disciplines, in many cases this interest is not cultivated outside the moment of the curricular lesson, thus preventing the qualitative leap from a functional study to the achievement of a school evaluation positive to an autonomous desire for knowledge and deepening of one's own skills and abilities in the technical-scientific field;

- in many cases the methods used by the teachers in the administration of the contents of the STEM disciplines are closer to the learning method experimented by the teachers when they were themmselves a teacher rather than presenting a real attention to the new needs and the changed conditions within which the new generations find themselves operating;

- modern students find it increasingly difficult to exercise continuous concentration on a single assigned task or on a single topic, also because the massive use of technology and in particular of the internet and digital has also accustomed them to a multitasking approach in processing questions information that comes from the outside world; however, teaching does not always take into account this transformation that has occurred over the course of a generation and the price to pay is very often an effective incommunicability of the disciplinary contents on the didactic level;

- modern students often prefer an experiential approach to learning, which sometimes does not reconcile with the much more theoretical setting of the teaching of some STEM disciplines, especially when the teacher is not in a position to adapt his teaching to the specific *modus* of the student;

- although the students who attend schools today can be considered digital natives, the use of specific digital technologies in school remains in many cases rather limited and, on the other hand, the same students are not always educated to a conscious and optimal use of the tools at their disposal.[5]

Opportunities

The Horizon Europe programme

Among the factors that constitute a valid incentive for the diffusion of an environment conducive to learning STEM disciplines also through the use of new teaching methodologies, a first-order role must certainly be recognized for the initiatives that see the EU engaged in the financing of projects

[5] An example of a survey of students' perception of STEM disciplines and their learning is available in: D. CEDERE, R. BIRZINA, T. PIGOZNE, E. VASILEVSKAYA, *Perceptions of today's young generation about meaningful learning of STEM*, Problems of Education in the 21st century, Vol 78, n. 6, 2020.

aimed at the dissemination and implementation of scientific and technological skills of the citizens of the member countries.
These include the **HorizonEU programme**, the European Union framework program for research and innovation for the period 2021-2027, which is being prepared starting in 2019 and has benefited from the reflection stimulated by the pandemic crisis of the immediately following years.
The program[6], a direct continuation of the previous Horizon 2020, has a duration of seven years being calibrated on the long-term budget of the EU, and puts in place a total funding of 95.5 billion to finance research and innovation activities. Of these, 25 are intended for the promotion of scientific excellence, which represents the first pillar of the specific implementation program of Horizon Europe 21-27. In particular:

- 16 billion for the European Research Council
- 6.6 billion for the Marie Sklodowska-Curie Actions, aimed at providing new knowledge and skills through mobility and training experiences
- 2.4 for the creation of cutting-edge research infrastructures.

Even the second pillar ("Global challenges and European industrial competitiveness"), especially in some of the thematic poles in which it is divided, presents a perspective of interventions in which the STEM disciplines, implemented by an innovative teaching, will be able to cover the role of protagonists:

- Cluster 4 (Digital, Industry and Space)
- Cluster 5 (Climate, energy and mobility)
- Cluster 6 (Food, bioeconomy, natural resources, agriculture and environment)

The Horizon Europe legislation also identifies some types of impact to be verified in order to monitor the achievement of the objectives. Among these, the scientific impact, which is divided into three areas:

1. Create new high-quality new knowledge
2. Strengthen human capital in R&I
3. Fostering diffusion of knowledge and Open science

The program also aims to strengthen and broaden participation and strengthen the European Research Area (ERA), through a whole series of targeted actions that are divided into the two macro-areas of broadening participation and dissemination of excellence and reform and strengthening the European R&D system:

Widening participation and spreading excellence

- Teaming, Twinnings, ERA chairs
- European cooperation in science and technology (COST)
- Boosting National Contact Points (NCPs) activities, pre-proposal checks and advice
- Brain circulation
- Excellence initiatives

[6] See the website: www.horizon-eu.eu

- Possibility for entities from widening countries to join already selected collaborative R&I actions
- Recognition of participation
- Matchmaking Services

Reform and enhancing the EU R&I system

- Strengthening the knowledge base for R&I policy
- Foresight
- Support for policy makers in developing the ERA
- Support to national R&I policy reform, including the Policy Support Facility
- Attractive researcher careers and links with higher education
- Open Science, Citizen Science and Science Communication
- gender equality
- Ethics and Integrity
- Support to international cooperation
- Scientific input to other policies
- Support to the Program implementation
- Support for National Contact Points
- Support to dissemination and exploitation

It is therefore evident how the objectives of the plan constantly intersect the promotion of STEM disciplines and the dissemination of scientific and technological culture achieved through an innovation of teaching methodologies and the pursuit of the ideal of an open science.
In this sense, specific initiatives carried out with the intention of bringing citizens closer to the world of science and STEM disciplines should not be overlooked either, overcoming the traditional prejudice according to which they are excessively complex and inaccessible to the general public and the majority of students. **The European Researchers' Night**, for example, is an initiative promoted by the European Commission, which every year since 2005, the year in which it was established, involves thousands of researchers, research institutions, schools in all European countries in an attempt to bring science to citizens, allowing the latter to get to know the most dynamic and stimulating face of scientific disciplines through the creation and presentation of scientific experiments and demonstrations, exhibitions, conferences, seminars, but also shows and guided tours useful for creating a context favorable to the so-called *edutainment*. The 2022 edition saw 26 European countries engaged in the implementation of various initiatives on the occasion of the event.

Work and occupation

Despite the economic-financial crisis of 2007-2008 and the recession that followed and despite the effects that the Covid-19 pandemic has had on national economies, it is noted that the unemployment rate for skilled STEM labor is very low and below the general unemployment rate since the beginning of the 2000s. This is true not only in the countries on which the effects of the crisis have hit less evidently, but also in those that have been most affected by it, proving that STEM professions have been much less affected over the last few decades by physiological and non-physiological fluctuations of the labor market, ensuring a constant or even increasing demand for workers.
According to Eurostat data, in 2021 there were around 74 million people aged between 15 and 74 who were employed in professions more or less directly related to STEM disciplines, the so-called HRSTO (Human resources in science and technology by occupation), a figure that marks a percentage increase of 2.7% compared to the previous year. Of these, 68.3 million are aged between 25 and 64,

2.3% more than in 2020. Within this category, a percentage of about 45%, for a total of about 30.8 million in absolute terms, it is made up of people aged between 45 and 64, the so-called 'senior' HRSTOs, while there are 17.6 million HRSTOs aged between 25 and 34, a percentage of the total number of 25.8 %.
Italy is the country in which the population of 'senior' HRSTOs is by far the highest, with almost 53.8% of the total, but also in the other EU countries, the percentage relating to this age group, although lower than to the Italian one, stands at a very high level.
The data therefore indicate a future scenario in which a large percentage of people currently active in STEM professions will reach retirement age and will therefore create a vacuum that will need to be filled through the recruitment of qualified personnel in STEM disciplines.
In general, the demand for qualified personnel in STEM disciplines is constantly growing, according to a trend that has not substantially changed since the 2000s. It is estimated that around 7 million jobs will be reserved for STEM professionals up to 2025, two thirds of which for the replacement of retired workers.
In spite of this demand, many Member States have experienced and still experience difficulties in recruiting skilled STEM manpower, particularly as regards technological occupations (engineering and ICT). The insufficient number of graduates and the lack of expert personnel is also part of the more general context of the crisis and the phenomenon of the so-called *Global Talent Crunch*, the expected decrease between now and 2030 in the availability of highly qualified people and workers in some strategic sectors such as for example those of technology and information. This problem, as indicated by the Korn Ferry consultancy in a 2018 report[7], will affect many countries between now and 2030, not only the developing ones, but also the more advanced ones, with a significant economic impact.
Therefore, the proportionally low number of students enrolling and completing STEM degrees and the persistence of a strong gender disparity in the educational paths and professions of this area will be as a matter of fact at the same time a probleme to face and a great opportunity for STEM students.

Threats

Digital divide

A 2018 study by the Organization for Economic Cooperation and Development (OECD)[8] highlighted a very significant figure regarding the state of awareness and familiarity with digital tools by the population active in the educational process: less than 40 % of people active in the education sector feel ready to use digital technologies in their teaching activities. While this figure varies a lot within individual member countries, it is indicative of a relevant problem that should not be overlooked.
Not even the youngest group is exempt from this issue: more than a third of young people aged 13 and 14 involved in an international study on the degree of IT and information literacy (ICILS), in 2018 had a satisfying level of mastery of digital tools. Very often this state of affairs reflects a social difference: a quarter of low-income households do not have computers and broadband access, albeit with many differences across the EU.[9]

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[7] KORN FERRY, *Future of Work. The Global Talent Crunch*, 2018 (disponibile qui: https://www.kornferry.com/content/dam/kornferry/docs/pdfs/KF-Future-of-Work-Talent-Crunch-Report.pdf).

[8] OECD, *PISA 2015: Results in Focus*, 2018 [Available at: https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf - Accessed 13 Nov 2022].

[9] For an overall view of the digital health status of the various EU countries, please refer to the DESI report (Digital Economy and Society Index) 2022, available at: https://digital-strategy.ec.europa.eu/en/policies/desi

Gender inequalities

The gender gap remains a big issue, with the presence of women at a much lower level than that of men, both in enrolling in a STEM faculty and in continuing their working career according to a choice consistent with their training path. And although this phenomenon is more present in some countries, the problem of the gender gap in STEM disciplines is a problem that concerns the whole Union.
In fact, while in the other university faculties the presence of women has gradually increased, the STEM faculties still have a clear prevalence of the male component. Among the factors determining this state of affairs, the following should be mentioned:

• lower confidence in their own abilities, particularly applied to scientific disciplines;

• the fact that STEM is seen as a difficult path for women to take, often because of prejudices about discrimination against women in technical or scientific professions;

• the fear of necessarily having to make a choice between one's own professional achievement and building a family.

The situation remains the same even at higher levels of education, as in the case of PhDs. However, not all disciplines have the same percentage of female presence. In the natural sciences, for example, it stands at decidedly higher levels, while for the ICT sector, the percentage is considerably lower, as well as for the engineering disciplines.

Social inequalities

The data relating to access to STEM study paths and professions highlight the persistence of situations of disparity due to previous socio-economic disadvantages, which ultimately also have repercussions on the choices made by students at the end of high school. The environment in which children and adolescents grow up is in fact a decisive factor in many cases in defining the attitude they will have as adults towards particular disciplines, even STEM. In particular, the elements that can make the difference, encouraging or discouraging the choice to undertake a course of study or a career in the STEM disciplines can be summarized as follows:

- the presence of a family able to sustain and support, even financially, the training and didactic path;

- the presence of an education system capable of making up for any economic hardship on the part of the family of origin and providing all the useful tools for effective guidance;

- the educational level of the parents (children of people who have a higher level of education are more likely to undertake scientific-type study courses and on average also obtain better results);

- ethnic group of origin: it is evident that first and second generation immigrants are more disadvantaged in accessing university courses and register a significantly lower presence in STEM disciplines compared to their peers children of non-immigrants, proving that there is a problem of integration and equity of which STEM disciplines and professions are also a significant indicator.

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Sitography

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This type of analysis is an essential means of studying the situation of a type of activity in an institution or company, and thus being able to apply the necessary measures so that this activity can improve and achieve its proposed objectives. In the educational sector, SWOT is essential to carry out a critical and reflective observation of the activities carried out in educational centres, with the aim of promoting those activities that help students' competence development. In this case, the SWOT analysis is the strategic method that has been applied to examine the situation of gamification and STEM in the Spanish and Valencian education system, and more specifically in the IES Hermanos Amorós de Villena (Alicante).

The SWOT analysis uses four elements that are examined in order to obtain the state of the activity at a given time; these are weaknesses, threats, opportunities and strengths.

Weaknesses are all those internal elements that prevent the analysed activity from developing and achieving its objectives and success. Threats, in turn, are made up of all those external components that negatively affect the activity and the achievement of its success. Thirdly, opportunities are the external aspects that can be positive for the development and improvement of the analysed activity. Finally, the strengths are the elements within the institution that host the activity that positively affect it and help it to achieve the proposed objectives.

After studying the results of the SWOT analysis, it should be used to establish the most appropriate strategy for the success of the analysed activity. The consequent strategy following the results can be of several types. Firstly, survival, when the main objective must be to confront threats and minimise weaknesses. Secondly, defence, consisting of consolidating strengths and confronting threats. Thirdly, attack, which seeks to maximise the development of strengths. And finally, reorientation, which is applied when the focus of the changes is on exploiting opportunities and correcting weaknesses. Of course, it is often the case that several of the above strategies need to be implemented in parallel and/or complementary.

STEM EDUCATION: SCIENTIFIC INTERDISCIPLINARITY FOR COMPETENCE DEVELOPMENT

The term STEM stands for *Science*, *Technology*, *Engineering* and *Mathematics*, and refers to the way in which the different areas mentioned above are dealt with together in order to teach students to solve problems, to develop their creativity and critical thinking, and to work and research in a cooperative way. It is an innovative educational approach, which emphasises the pragmatic component of teaching, and which aims to confront students with concrete experiences that require their creative capacity and their ability to work in teams to tackle and solve them.

The development and presence of this methodology in the classroom is increasing, and today, while it is consolidating as a common means of learning in the classroom, it is also being renewed and updated with the incorporation of elements (as in the case of STEAM, which adds the artistic component to the scientific areas of the original term) or by specialising the method (as in the case of ST2REAM, where the focus is on a specific subject).

In any case, the overwhelming presence of digital elements in the classroom is a unique opportunity to incorporate them effectively into the teaching/learning process and to offer educational centres practices similar to those carried out in companies (López, Couso and Simarro, 2020). Moreover, it is an ideal medium for developing students' digital literacy and computational thinking, another of the great educational challenges of our century.

However, there are also articles that focus on the limitations of this concept and its application in the classroom (Bogdan and García-Carmona, 2021). Firstly, they criticise the ambiguity in its conceptualisation, since, together with the successive derivations in the form of acronyms, it is characterised both as a global educational movement and as a specific methodology, or, on occasions, as a banner vindicating scientific activity. Secondly, they argue against the supposed pedagogical novelty of the integration of scientific areas and the project work that is usually associated with STEM, as examples of similar ways of working can be traced throughout the history of education. Finally, they argue that many of the studies on the educational benefits of STEM are either based on too small samples from which generalisations cannot be made, or their samples do not focus on the interdisciplinary concept of STEM, but on partial views of it.

In any case, these criticisms should be used to make progress in the aspects indicated; a clear delimitation of the concept, a true renewal of its pedagogical meaning and a scientific literature based on real and significant samples can help schools to open the doors of their classrooms to STEM methodology.

GAMIFICATION: GAMES AS A TOOL FOR STUDENT MOTIVATION

Gamification is a teaching/learning method that applies game dynamics to the educational environment in order to improve the development of student skills. Gamification practices are based on the achievement of objectives during the development of the activity, so that students obtain rewards during the game. In addition, gamification tries to achieve the most significant learning possible through the experimentation of the student, who is fully integrated in a playful experience in which play and learning form an inseparable whole. Thus, the motivation of the students, their close connection to the activity and its objectives, as well as the stimulation through rewards, are three basic characteristics of the gamification strategy in the educational field. In addition, other features that determine game-based learning have been referenced, such as its contribution to the development of personal initiative, learning to work cooperatively, and its imaginative and creative potential, among many others (Cerezo, 2022).

However, an effective application of gamification techniques must be accompanied by certain requirements that direct the activities towards educational success. Suitable resources and infrastructure are necessary for gamification (internet connection, devices with access to gamification platforms, etc.). Moreover, gamification is not simply the application of a game, but the concept includes a high degree of planning, a thorough reflection of the objectives to be achieved and the competences to be developed. This is one of the possible reasons why its implementation is slow and isolated, the organisational and reflective demand it requires from teachers.

THE SITUATION OF STEM IN THE SPANISH AND VALENCIAN EDUCATION SYSTEM

One of the signs from which we can deduce that the implementation of STEM in Spain and the Valencian Community has improved is the scarce number of articles devoted to analysing its presence in Spanish classrooms, which contrasts with those devoted to other countries, even by Spanish researchers. Most of them are devoted to the study of its presence in primary education and at university level, but the limited number of studies devoted to secondary education is striking, which may be directly motivated by its lower level of implementation. One of the reasons for this may be the traditional separation of scientific areas at this stage, which is not so accentuated in the other educational periods mentioned. As a result, Spain is below the European average in STEM graduates (Tamargo, Agudo and Fombona, 2022), which is also a symptom of the lack of consolidation of this model in our education system.

The initiatives of the Catalan education administration in favour of the presence of STEM in the classroom stand out. The STEAMcat Plan (2017) contains, among others, actions dedicated to teacher training, and the possibility (but not obligation) of helping to implement projects of this type in the classroom. Another study conducted in Catalonia suggests once again that the development of STEM in Spain is still at an early stage, as teacher surveys on the concept of STEM and how it is put into practice in the classroom show that the term and its implementation are still ambiguous and confusing, indicating conceptual and practical immaturity (Torras, Lope and Carrió, 2021).

On the other hand, initiatives in the form of competitions or tournaments are also noteworthy. The First Lego League is an international programme that seeks to promote the STEM philosophy among young people aged 14 to 16, starting in schools. This competition is one of Spain's strongest efforts to develop STEM projects in the classroom. Other private initiatives also have similar objectives to those mentioned above, such as the STEM League or the different projects carried out by the STEAM Alliance promoted by the Ministry of Education with the help of different companies. This Ministry also offers teacher training in STEM, currently through the *Classroom of the Future* project, which also emphasises the material resources and spaces necessary to fully develop the pedagogical mechanisms of STEM. In this sense, another of the reasons given for the lack of STEM implementation in Spanish classrooms is the unavailability of adequate infrastructures for its implementation.

For its part, the educational administration of the Valencian Community is also beginning to develop innovative projects in which the STEM philosophy is one of the basic components. In this case, the *Aules Transformadores i d'Espais i Metodologies Educatives* project aims to develop proposals for the organisation of spaces that favour the development of student competences; through conferences and teacher training, the aim is to offer schools the possibility of developing active methodologies in their classrooms and, as far as STEM and secondary education are concerned, through the *Espais y aules STEM* course.

It is also important to point out that one of the main reasons for the implementation of STEM methodology in Spanish and Valencian classrooms is the reduction of the gender gap in the university and research world. The scarce presence of women in scientific fields of this type calls for a series of actions on the part of governments that are resulting in the choice of STEM as a means of overcoming these stereotypes and motivating female students to opt for scientific studies (Monsalve, 2018). Research also points to the inaction of education policies in extending interdisciplinarity as a decisive factor in this gap, but also in overall school failure. In general, studies on the gender gap in STEM disciplines have been abundant in recent years, but the scientific literature does not really reflect on how STEM is implemented in Spanish and Valencian classrooms.

In short, the first steps are still being taken towards the generalisation of STEM teaching strategies in Spanish classrooms, especially in secondary schools. However, the growing interest of educational administrations and teachers, together with the social need to incorporate women into technological studies and professions, broadens the possibilities for growth and expansion of this innovative methodology in our educational centres.

GAMIFICATION IN SPAIN AND IN THE REGION OF VALENCIA

Gamification requires the active role of two agents in order to be carried out in classrooms; on the one hand, the teachers in charge of applying this methodology in the classroom, and on the other hand, the entities (often companies, but also the teachers themselves) dedicated to developing the games that should serve as material for teachers and students. The analysis of the situation of these elements can shed light on the state of gamification in Spanish and Valencian classrooms. Moreover, the publication of scientific articles on gamification is also an indicator of the situation of this methodology.

In the case of the creation of educational games, Agustín Fonseca was a pioneer with the creation in 2012 of *Cazafaltas*, an application dedicated to spelling correction and rudimentary in appearance from today's perspective. Also noteworthy as an initiator of gamification in Spain is Santiago Vallejo and his project *Zombiología (*2013), designed for the area of Biology and Geology and which is complemented with the ABP methodology (Jiménez, 2018). However, despite the years that have passed since the first gamification initiatives in Spain, there is no detailed study on the gamification projects carried out in our country and in the Valencian Community, but through the bibliography published on the subject we can obtain an overview of their projection in the current education system.

There are quite a few gamification projects in the area of Social Sciences, and there is even an article dedicated to the study of these (Prieto and Álvarez, 2021). In general, most of them are oriented towards the university environment, with strategies based on computer game platforms and of a cooperative and competitive type. Despite this, some samples of gamification in secondary education are cited. For example, the *Libertus* project, aimed at the teaching of history, is found for 1st ESO. On the other hand, gamifications based on video games set in historical periods and representing the eras or periods being studied are quite common. There are experiences applied to the Roman Empire (*Imperator: Rome*), the medieval period (*Crusader Kings II*) or the Modern Age (*Europa Universalis IV*). In addition, there are video games centred on world wars, such as *Hearts of Iron IV* (Campillo and Casado, 2022).

One of the areas in which gamification has the greatest presence is Physical Education. There are numerous publications that analyse gamification projects in this area, such as one inspired by the game *Clash of Clans* (Muriel, Alonso, Rodríguez and Pérez, 2021). Less common are gamification proposals applied to the teaching of foreign languages and languages in general, where there are hardly any examples applied to this area. As an isolated example, the one analysed by Gil and Soto (2021), based on Genially and with the aim of stimulating French language learning, stands out.

With regard to gamification applied to STEM, it is also possible to study the general situation from the published scientific literature. One of the main factors affecting the scarce presence of gamification in STEM in Spain is the general tendency to separate the teaching of disciplines that form part of STEM, such as Mathematics, Technology or Physics and Chemistry, into watertight compartments. Project-based organisation is the ideal way to convey gamification and STEM, and it is a way of working that is not yet very well established in the Spanish and Valencian education system. Despite this, Fuentes and González (2019) identify different proposals in secondary education in which gamification and STEM are unified in the classroom. Studies on these point out as benefits in teaching/learning the increase in student motivation, the improvement of classroom management and the improvement in academic results. In addition, González, Ramos and Vásquez (2021) indicate another of the advantages of gamification applied to STEM, the immediate feedback provided by the platforms and applications used, which enables greater motivation and more direct and effective learning. To a lesser extent, the development of mathematical competence or collaborative work are indicated as other achievements reached with this type of methodology. Among the game elements present in the gamifications developed in STEM projects, those centred on points ranking, challenges and challenges and those involving prizes stand out. Likewise, the technologies implemented in the development of these projects are mainly *ClassCraft* and *Class Dojo*, as well as *Arduino* and *Lego Mindstorm* for robotics projects.

In conclusion, the experiential and experimental nature of the organisation of scientific areas in STEM increases student motivation and helps them to understand concepts through their application in realistic and practical situations provided by the game. The gamification methodology, in conjunction with the STEM organisation, promotes meaningful learning by immersing students in situations that simulate reality. All of this provides students with the necessary excitement to want to understand and show curiosity for curricular learning (Fuentes and González, 2019).

In addition to the specific studies mentioned above, there are also projects in which Spanish schools collaborate with other European schools to extend the implementation of gamification and STEM. This is the case of the project led and explained by Serrano, Rioja and Cabrera (2019), called *Stimey*, whose objective is to promote scientific and technological studies among students aged between 10 and 18 and to promote them through motivating methodologies such as project-based work and gamification.

In relation to this, the situation of teacher training to gamify their classrooms through the STEM organisation has also been studied (Fuentes and González, 2017). In this sense, the need to motivate students requires innovative and up-to-date teacher training for a complex task such as teaching. This training should focus on three aspects: content, pedagogical knowledge and technological knowledge.

Regarding the first, it is necessary to promote knowledge about the connections offered by the different STEM areas, as most teachers demonstrate a high degree of knowledge of the contents common to the different areas. Secondly, there is an urgent need for specific teacher training in active methodologies, and specifically gamification; this does not only involve mastery of the tool, but also knowledge of the characteristics of the gamification process (curiosity, companionship, competition, among others) for the appropriate development of the teaching-learning process. Thus, it is also important to train teachers in the gamification of classroom management processes, as they directly favour the teaching/learning processes in the STEM area. Fuentes and González (2019b) propose a *checklist* so that teachers can check the suitability of their gamified STEM teaching proposals; this proposal has been validated in practice on the basis of different projects analysed, and it highlights novel elements with respect to traditional teaching units, such as the engineering approach (the way in which the STEM content worked on serves to generate significant learning: through a challenge, a simulation of reality, etc.), the level of gamification (the way in which the activities are gamified: if they are all gamified, if they are all gamified in the same way, if it also affects classroom management, etc.) or the final product (the materialisation of a product that solves the proposed challenge or the tests presented). Finally, training for learning to use ICT tools, as well as knowing the criteria for selecting them depending on the objectives and competences to be achieved and developed, are two other compulsory components of teacher training.

On the other hand, the connection between inclusion and gamification is also being progressively claimed and developed in our classrooms. Specifically, Vidal (2019) places gamification strategies as a fundamental axis to respond educationally to the inclusion needs of students. The author argues that gamification, while being a means of student inclusion, must also take into account the different student profiles and develop relevant inclusive strategies. In relation to this, it has already been highlighted how gamification can help students' enrolment and retention in school. The benefits of gamification in preventing dropout include increased motivation, better academic performance, efficient use of time, greater engagement with the subject and improved self-esteem. In addition, they enable the individualisation of learning processes, thereby reducing inclusion gaps and reducing exclusion and marginalisation (Rodríguez, Ramos, Santos and Fernández, 2019).

In conclusion, gamification in Spain is still in its infancy. All the factors mentioned above need to be developed in order to extend the gamification methodology in a generalised manner in Spanish and Valencian classrooms. Quite significant in this sense is the observation of the sample of gamification experiences that Faure, Calderón and Gustems (2022) present in the article where they review the presence of gamification in secondary education: the presence of experiences in Spanish and Valencian classrooms is minimal in the article, which demonstrates the needs and incentives that it should have on the part of teachers, trainers and educational administrations.

DAFO ANALYSIS OF THE SITUATION OF GAMIFICATION AND STEM AT THE IES HERMANOS AMORÓS IN VILLENA (ALICANTE)

The arguments explained so far in favour of the application of gamification and STEM methodology for its various advantages for the consolidation of student learning are the reason why from IES Hermanos Amorós we have considered implementing these active methodologies in the centre. Specifically, the main objective is to combat school dropout through these methodologies, as it has been demonstrated in previous sections the benefits in the students and specifically in those with greater chances of not continuing their studies.

To this end, we have carried out a SWOT analysis of both approaches, gamification and STEM, on the basis of which we have been able to establish a strategy for the centre in order to take advantage of the strengths and opportunities, combat the threats and overcome the weaknesses.

Before starting with the two essential points of this section, we must explain the difficulties we have encountered when carrying out the SWOT study on the use of STEM and gamification in our school in order to then compare the data at the population, autonomous community and national level.

The first obstacle we encountered was the lack of willingness of the other schools in the town of Villena to respond to our questions; if it is normally difficult for all the teachers in a school to carry out this type of study, it is even more complicated when you try to extend this study to neighbouring schools that are not directly related to the project in a direct way. The number of responses received from teachers from other secondary schools in Villena has been very low, and this has made it difficult to extrapolate and compare the results of the SWOT of IES Hermanos Amorós with respect to other schools within the same area of influence.

Secondly, we have come across a rather scarce number of studies on this subject at the level of the autonomous community, since, after contacting the Evaluation and Studies Service of the Directorate General for Educational Innovation and Academic Organisation, we were informed that no SWOT study had been carried out in the Valencian Community regarding the situation of the use of STEM methodology and gamification. This is increasingly complicating the development of this section of the guide by the Spanish team.

Finally, and following the same line, when we looked for studies at national level that could help us to mark a certain point in the situation of IES Hermanos Amorós with respect to other higher levels, we again came up against a large absence of reliable data based on real SWOT studies.

In order to carry out the SWOT study on the situation of the use of STEM methodology and gamification in our centre, we have created a survey that has been sent to the 105 teachers who work at IES Hermanos Amorós. The teaching staff of the centre teaches in Compulsory Secondary Education, Baccalaureate and Basic, Intermediate and Higher Vocational Training, so the range of different situations is very wide, and therefore the results of the questionnaire are also very wide. Although not all the teaching staff responded to the questionnaire, it must be said that the vast majority of the teaching staff did, and the data we have obtained are suitable for the study. This questionnaire, as well as having been completed by the teaching staff of our school, has been sent to the senates of the other 5 secondary schools in the city of Villena, although, as we have said before, the necessary data have not been obtained from these schools.

Having explained these difficulties in conducting and comparing data, we can begin with the actual commentary on the analyses conducted.

With regard to gamification, the following conclusions can be drawn from the SWOT analysis:

WEAKNESSES

Firstly, the greatest weakness is in line with what has been pointed out in the various studies mentioned above; the lack of training of the school's teachers limits the school's capacity to implement a gamification methodology. In addition, the inexperience of the teaching staff in implementing this type of activity in their classrooms is also a negative conditioning factor. Lastly, teachers point out the lack of time for the organisation and development of gamification units, which is related to the inherent demands of this type of methodology, which has been identified as an obstacle to the development of gamification initiatives in educational centres.

THREATS

Secondly, one of the main threats detected is low student motivation, since, although the main benefits of gamification include increased motivation, students must have a minimum predisposition towards the activities proposed. Linked to this is another threat, the problems of student disruption, which translates their lack of motivation into behavioural problems. Likewise, another localised threat is the difficulty in creating appropriate and motivating themes that connect conveniently with the possibilities offered by gamification. Finally, the confusion between game (playful activity) and gamification (gamified activity), one of the dangers pointed out in the studies on the subject, can lead to playful proposals with no impact on teachers' skills, or to confusion on the part of students about the objectives they wish to achieve with this methodology.

OPPORTUNITIES

On the other hand, there are different opportunities that arise from the possibility of establishing gamification as the backbone of the centre's educational action. Firstly, gamification is a methodology in full development, whose possibilities for evolution are still enormous, and it has a promising future as a predominant methodology in the classroom. Secondly, it offers the school the opportunity to develop an innovative project that generates new expectations in students and teachers and conceives a new confidence in a didactic possibility different from those worked on until now. Thirdly, there is the opportunity to increase the level of student motivation, an objective for which a thoughtful and long-term approach to the implementation of gamification in the school must be taken. Finally, as has been pointed out when describing the possibilities offered by gamification methodology, it fits perfectly with project-based learning, another of the active methodologies being developed at the school; the combination of both can also favour them and project them as a unitary didactic strategy that takes advantage of the best qualities of both.

STRENGTHS

Finally, the SWOT analysis indicates that several strengths were found. Firstly, despite their lack of training, the teaching staff are predisposed to learning this methodology (83%), although almost half do not put it into practice (48%). Moreover, they perceive themselves to have sufficient command of ICT to be able to generate gamification teaching materials, and specifically their knowledge of the basic tools for gamifying the classroom stands out (89% make use of them to increase student motivation). In addition to this, the teaching staff are in favour of the development of active methodologies and defend and practice their implementation in the classroom; specifically, 87% of the teaching staff are in favour of the use of active methodologies to improve performance, and 93% state that they make use of them in the classroom. In short, one of the school's strengths is the personal and professional motivation of the teaching staff and their interest in improving their teaching practice by means of learning through play.

The SWOT analysis of gamification at IES Hermanos Amorós presents conclusions that are largely similar to those drawn from the analyses carried out at other centres. Thus, the use of the methodologies is presented in the majority of the centres analysed, where work is mainly carried out using PBL (Project Based Learning) and *Flipped Classroom*. Kahoot, Canva and Genially are common tools in the application of these methodologies. In addition, the threat of student demotivation is also observed in other schools, as the level of student motivation ranges between 5 and 7 points. Finally, the strength of teachers' interest in learning gamification strategies is also present in the SWOT analyses of the schools studied.

The other SWOT analysis that has been undertaken has been around the STEM methodology. As with gamification, the school's long-term goal is to introduce the STEM philosophy into our classrooms, and it is important to determine what positive and negative elements are in place to meet this goal.

WEAKNESSES

Firstly, the greatest weaknesses detected are of a material and organisational nature. On the one hand, the proper development of the STEM system requires a diversity of spaces and material resources which the school does not currently have. In addition to this, a demanding level of coordination between the areas and the teaching staff involved is considered essential, which requires complex timetable management. Likewise, there is a weakness in the perception of the scientific areas by the teaching staff, who generally tend to interpret each of them as separate and independent compartments, a view that may hinder the proposed objective.

THREATS

Secondly, and as in the SWOT applied to gamification, the demotivation of the student body, and specifically the lack of motivation from work in scientific areas, can be a serious obstacle for the STEM system. We believe that these threats could in turn become an opportunity when the STEM methodology is implemented in schools, as it would serve to motivate students.

OPPORTUNITIES

In terms of opportunities, the commitment of educational administrations to STEM methodology presents the ideal situation to achieve the integration of STEM in our centres. In addition, the progress of its generalisation in Spanish and Valencian classrooms motivates the need to take advantage of this globalising trend in order to share experiences and join forces and proposals with other centres to achieve common objectives in STEM. Likewise, the current social concern about the gender gap in scientific disciplines makes it necessary to focus on inclusive perspectives such as the one shown by STEM, turning this contest into an opportunity to reduce this gap at the same time as the STEM philosophy penetrates the school.

STRENGTHS

Finally, several strengths have been detected. On the one hand, the teaching staff consider themselves sufficiently competent in terms of content to be able to teach in an interdisciplinary and globalising way; furthermore, they are interested in training in the active methodologies required by this type of teaching approach. On the other hand, the school already has some experience in 1st ESO in the way of working by areas in the science-technology module, so that both project work and scientific interdisciplinarity are not completely new at the school. Similarly, our school has experience in educational robotics, a subject taught by teachers of Technology and Mathematics who have participated on several occasions in the First Lego League and have achieved significant success in it.

In conclusion, the SWOT analyses allow us to establish a long-term plan to establish gamification and STEM as fundamental guides for teaching in our centre. The progressive dissemination of these methodologies, the willingness of our teaching staff to innovate and their conceptual and pedagogical competence, among others, are the weapons with which to establish a strategy of progressive implementation in our classrooms that manages to combat demotivation and student dropout.

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4.3. CROATIA

SWOT analysis in education

The name SWOT analysis is an abbreviation of the four English words STRENGTH, which means strength, WEAKNESS, which means weakness, OPPORTUNITIES, which means opportunity, and THREATS, which means threat. SWOT analysis is an economic research that determines strengths, weaknesses, opportunities and threats for a certain area of interest. Strengths show the area where what we are researching is good, quality, competitive and that is what should not be changed. Weaknesses are shown in the area where what we are researching is not good enough, nor competitive, and that is what definitely needs to be changed and needs to be worked on further. By analyzing opportunities, we can see in which direction we need to develop what we are researching and where we can gain an advantage, while analyzing threats gives us a clear insight into certain difficulties we may encounter in the near future and what we need to think about additionally.

Our SWOT analysis is oriented towards education, and the analysis includes the STEM field in the teaching process, as well as gamification.

SWOT analysis of education in the Republic of Croatia

The SWOT analysis on STEM and gamification was conducted at the vertical (primary and high school) level and at the horizontal (school, county and state level). It included teachers of science and mathematics subject groups (chemistry, physics, geography, mathematics) and professional (databases, programming) and informatics subject groups. The analysis was conducted on a total of 30 teachers, 10 of them in primary school, 20 in secondary school (10 from our school, 10 from other schools).

The results of the SWOT analysis can be seen in the following table.

STRENGTHS	WEAKNESSES
- a wide range of educational programs - students' motivation and interest in the STEM field - highly competent and professional teaching staff - motivation of teachers - challenging nature of the content taught in the STEM group of subjects - participation in various school, county, state and international projects - a wide range of possible jobs after completing secondary school - popularization of STEM - creation of classic games for the purpose of the educational process - creation of digital games for the purpose of the educational process - availability of already made games for educational purposes - implementation of games in the educational process	- investment in educating the teaching staff - insufficient time for the implementation of STEM projects - attention focused on technology, not on actual knowledge acquisition - teachers with many years of work experience do not have the motivation to advance, nor the ambition and desire to achieve success and learn new things - lack of material resources - inadequate investment - long preparation of STEM projects - relying on the effort of the individual without specific help from institutions - evaluation through games is not objective - inadequate familiarity of teachers with the method of evaluation through play - strict use of time and game mode

- the quality of achieving educational outcomes - student motivation - student involvement and interaction - content upgrade and linking - quick availability of results, feedback and evaluation - evaluation method - active role of students	
OPPORTUNITIES	**THREATS**
- investment in education - expertise of teachers - recruitment of new teachers - life-long education - launching new educational programs - more active learning and formative evaluation - developing other forms of the teaching process - correlating of the labor market with educational programs - continuous development of technology - evaluation of participation in all projects and additional matters - monitoring the dynamics of the development of the educational system - interdisciplinarity - focus on concrete - innovation - visualization - monitoring the development of technology - interactivity - teaching staff education	- unmotivated and uneducated teachers - pressures from parents regarding evaluation - additional work of teachers - insufficient investment in education - students spend too much time on mobile devices - the education system is inefficient and harms all participants in education - the labor market is not in line with educational programs - there is no interest in craft occupations with a deficit, while those with a surplus are still offered upon enrollment - inability to connect and adjust - spent on searching for and creating materials - the game can easily direct the student's focus to something else - poor internet connection - poorly equipped schools

Results of the SWOT analysis on STEM

Strengths

In the last few years, with the development of digitalization, the popularity of STEM is growing both in the real sector and in the educational sector.

The education sector in the Republic of Croatia follows the trend of modernization of the education sector through digitization and popularization of the STEM field of education. The main bearers of this modernization are high-quality and professional teachers who, in addition to their competence, are also motivated. Quality, expertise and motivation are manifested in various projects at the school, county, national and international levels. In addition to teachers, there are also highly motivated students who recognize the need for knowledge and skills and competencies acquired through STEM subjects, and respond to all the demands of their teachers. Students are happy to get involved in the already mentioned projects, and after finishing elementary school, they choose different programs from a wide spectrum related to the STEM field. After graduating from high school, students have the option of employment in various fields from STEM, i.e. enrolling in colleges that offer them continuation in the field they chose in high school or some new field related to STEM.

Weaknesses

Along with the strengths, there are certain weaknesses associated with the STEM field in education.

In the education system of the Republic of Croatia, there has been a large deficit of STEM teachers in the last few years. During employment, experts from the STEM field primarily choose jobs in the real sector due to higher incomes, while a smaller number of experts decide on employment in the education system. In certain parts of the Republic of Croatia, STEM subjects are taught by non-professional teachers, which leads to weaker results in achieving educational outcomes in STEM subjects. In addition, this is also reflected in the reduced number of students enrolled in teaching majors in the STEM field.

Within the teaching process, teachers are generally not motivated to create STEM projects. The reason is that it takes a lot of time to prepare and create STEM projects, and if the teacher decides to take that step, he is mostly alone, without the support of institutions. Also, the realization of a STEM project requires a lot of time, which teachers do not have in their classes.

Occasions

The popularization of STEM in the real sector brings certain opportunities in the education sector.

The first big opportunity is investing in education. Investment can take place through several different segments. One of the segments is certainly equipping schools with appropriate teaching aids for the implementation of STEM subjects (computers, projectors, Internet connection, specialized classrooms and laboratories, etc.). The next segment is teachers. Teachers should be further motivated and educated through various training programs in order to keep up with new technologies that follow educational standards, to encourage lifelong education. It is extremely important to encourage teachers to implement projects, which will then be additionally evaluated, as well as participation in all additional matters related to education. Also, an important segment is the harmonization of the labor market with the offer of educational programs in schools, but at colleges. It is important that students have the option of choosing a specific high school program with which they will be competitive on the labor market after finishing high school or will be able to continue their education at the chosen college. Encouraging enrollment in teaching majors at STEM faculties with additional scholarships, guaranteed employment and other motivating activities.

Threats

Threats to seriously consider when it comes to STEM education are as follows.

In primary and secondary school, there is a lot of pressure from parents on STEM teachers. The demandingness of teaching programs results in poorer adoption of educational outcomes, and parents and students show their dissatisfaction. In this process, teachers are exposed to different types of threats without certain system support. The result is unmotivated teachers who decide to organize classes simply, without additional activities and projects, or leave the education system. The departure from the education system results in a reduction of STEM subject teachers, whose positions are then filled by uneducated specialists. The teaching process is then not at a satisfactory level. Another threat is that students are not enrolled in teaching courses. In the past few years, teaching majors have enrolled only one or two students. This information is frightening, and the true extent of the damage will be seen in a few years when there will be no educated teachers to teach STEM subjects. Also, except for teaching majors at faculties, interest decreases or is absent at all for deficit craft occupations. The system becomes non-fluent and harms all participants in education.

Results of SWOT analysis on gamification

Strengths

In modern teaching, teaching of the 21st century, teachers had to enrich or even replace classical teaching methods with new, digital ones. One of such methods is the gamification method.

Gamification models have always been part of the teaching process, but in addition to traditional gamification models, digital gamification methods are now also present. In addition to teachers themselves creating different gamification models, most publishers are also becoming aware that the demand for pre-made gamification models is high. On their platforms, they offer teachers different models of gamification and conduct professional training so that they themselves are motivated to create their own materials. Independent creation of games and gamification models requires a lot of time, which some teachers decide to do. The implementation of gamification in the teaching process, with clearly defined rules, is quite simple. Students are motivated to work because through gamification they achieve simple educational outcomes, but also more complex ones that require them to upgrade and connect content. Through gamification, students are encouraged to be creative, to take responsibility for their own and team work, how to successfully communicate and generally interact with other students and teachers.
The popularity of gamification in the educational process is great because the results are quickly available. At the end of the gamification, the students, as well as the teachers, have information about whether and at what level the students have achieved the given educational outcomes. Also, feedback on how to improve results and in what way is immediately available. Finally, the evaluation is also important, which gives the teacher feedback from the students about how satisfied the students were with the gamification.

Traditional gamification models are popular in classroom teaching (grades 1-4) because it is still intuitive for students (aged 7-10) to play and learn through play. Through traditional gamification models, students achieve simpler educational outcomes, while in subject teaching, depending on the grade (5th - 8th grade), the number of traditional models decreases and the number of digital gamification models increases. Students (aged 11 - 14) are progressing in terms of computer literacy and digital models are very easy to implement. High school students (aged 15-18) are computer literate enough to implement digital gamification models without difficulty, but also for the students themselves to design and create a specific digital gamification model. The number of gamification decreases depending on the class - students in the final grades of high school use gamification the least in the teaching process.

Weaknesses

In addition to the mentioned strengths, there are also weaknesses of gamification in the educational process.

Teachers of the younger or middle generations are open to new teaching methods, and therefore gamification, while teachers of the older generations are quite closed to them. They do not feel confident or competent to create a gamification model, and sometimes not even to implement it. Some of the teachers still use ready-made gamification models, but even for that they need additional personal preparation, as well as the preparation of the students. Sometimes everything comes down to the effort of the individual without the concrete help of institutions, and the motivation of teachers therefore decreases. Teachers, in addition to regular work, preparing and conducting classes, should additionally allocate their time to create gamification models, which many refuse. Evaluation through games can be realistic, but many teachers are of the opinion that evaluation through gamification is not realistic because certain outcomes are difficult to adopt only through gamification. Also, teachers are sometimes not sufficiently educated and instructed on how to evaluate students through gamification. Another weakness of gamification is the use of time. Gamification models are interesting to students, but there is a danger of excessive use of gamification in the teaching process, but also as a method of evaluation. If mobile devices are used during the implementation of gamification, students can misuse it and thus endanger the implementation and evaluation itself.

In elementary schools in the lower grades (1st-4th grade), simpler gamification models can be implemented, but it takes a lot of time to prepare the students. In the higher grades (5th - 8th grade), students learn the rules faster, but the gamification is more complex and the creation takes more time for the teachers. In secondary school (grades 1-4), teachers independently create gamification models less often due to the complexity of the educational outcomes, and are more inclined to take over ready-made models. Downloading ready-made models also takes time for teachers, because sometimes teachers do not know where to look for the models they would like to use in class, or the models they find do not suit them partially or completely, which then results in abandoning the application of gamification in the teaching process.

Occasions

During the 21st century, technology has advanced a lot and, accordingly, new opportunities have appeared in the creation and use of gamification.

Different gamification models can be visually very well made, which is crucial in today's technology world. Various natural, mathematical, physical and chemical laws can be presented well through various animations, graphics, video works, models, etc., which makes it easier for students to understand abstract content, for example from mathematics, physics, chemistry. Students can also focus on the specific. Complex problems can be solved interactively, using interdisciplinarity and combining different knowledge and skills. Considering the course of technology development, there is also an opportunity for further development of the digitization of education in general, but also the digital development of the teaching process in particular. Along with the digital development of the teaching process, it is also an opportunity to further motivate and educate the teaching staff.
Another opportunity is to establish a system at the national level that would be in charge of designing and creating different gamification models. This system would consist of experts from several different fields who would create the environment necessary for the implementation of gamification, design and create different activities for students, develop a system of evaluation - from feedback, ways of progressing in scale with different levels of educational outcomes, evaluation for learning, evaluation as learning, and evaluations (grades) and evaluations.

Threats

The development of digital technologies greatly facilitates the teaching process, but we must be aware that digitization also brings us many threats.

Although the 21st century implies a high level of equipment in schools and the availability of the Internet everywhere, this is not the case in all parts of the Republic of Croatia. There are still schools, primary and secondary, that are not equipped with the minimum basic conditions for work, which means that all students do not have equal conditions for learning and work. Some parts of the Republic of Croatia are still not covered by a stable Internet connection, which is necessary for working on digital educational materials in general, and then also digital games. If the school does not provide basic conditions, parents are sometimes expected to compensate for the same, which again leads to difficulties. The socio-economic status of the parents can also be low, and thus they themselves cannot provide the student with everything he needs.

In addition to the socio-economic status of the individual and the difficulty of basic minimum conditions in the schools of the Republic of Croatia, there are threats as a consequence of digitalization. Outside the teaching process, students are surrounded by extremely strong digitalization, and additional digitalization in the teaching process no longer motivates students, but on the contrary, students are saturated with digital content and digitalization in general.

If teachers decide to implement gamification in the teaching process, certain difficulties may arise. One of the difficulties is certainly the reduced concentration of students, as well as the distraction from educational outcomes. Also, students can only focus on progressing in terms of competition, and not on achieving certain educational outcomes. The student can also use illegal methods here. Excessive use of gamification can lead to addiction to this way of learning.

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SWOT ANALYSIS VIA STEM AND GAMIFICATION

The use of gamification in the classroom, primarily in the so-called MINT subjects (mathematics, computer science, natural sciences and technology), referred to in English as STEM fields (science, technology, engineering and mathematics), has been increasingly researched and promoted in recent years. With the ever-increasing digitalization at schools in Germany, as well as in many other countries, gamification is playing an increasingly important role in the classroom. Students born after the year 2000 have already grown up with digital media. The use of tablets, mobile phones and the navigation and use of the Internet are no longer new territory for them. Digitalization determines their everyday lives, usually from primary school age. Be it using social networks, doing homework, preparing presentations or studying for performance records, as well as afternoon entertainment while playing online games. The students of today's generation spendseveral hours a day in contact with digital media. Gamification uses the fact that the students have grown up as "digital natives" to achieve positive results for the classroom, e.g. in terms of learning success. Focubierta and Rodriguez[1] explain that problems such as inattention in class, inaction, incomprehension and comprehension difficulties due to lack of commitment on the part of the students should be solved.

However, gamification is not the same as educational games. It is rather the opposite. According to Deterding, gamification can [2] be defined as the integration of game design elements into non-game contexts. Thus, a vocabulary memory is not gamification, but an educational game. This concept would be gamified if the children received points for learning the vocabulary in order to position themselves within a ranking.[3]

In the following, the topic of gamification is discussed using a SWOT analysis, i.e. the consideration of strengths (Strengths), weaknesses (weaknesses), opportunities and risks (threats) presented in more detail. The points mentioned here should be taken into account in order to ensure the most meaningful and efficient use of gamification in the classroom.

ADVANTAGES

The term gamification in the classroom, especially in the STEM fields , is associated with many positive expectations resulting from the rapidly advancing digitization in schools. Numerous advantages have already been explored in studies on this topic and arepresented in detail below.

A big advantage of gamification is **that it** makes **reading** fun . The learning effect takes place quite incidentally. The playful elements captivate the learner, increase the excitement and fun. For this purpose, reward systems are often used, as the learners know them from real games. Items or badges, for example, can be collected, this can increase motivation. Users are put into a kind of "flow". You will be completely immersed in the lesson, work more relaxed and concentrated. These are optimal conditions for effective learning. [4] Games allow students to gain their own experience of an activity without having to fear serious consequences.[5]

It also promotes the **creativity** of learners, a skill that is often neglected in normal school lessons. This also promotes innovation potential. [6] The knowledge acquired through gamification is transferred to the school

[1] (Foncubierta & Rodríguez, 2014)
[2] (Deterding, Dixon, Khaled, & Neck, 2011)
[3] (Dr. Osterroth, 2021)
[4] (Webcampus, 2022)
[5] (Stöcklin, 2018)
[6] (The Access Group, 2022)

and working world and promotes creative brainstorming, in which one can sometimes think "outside the box".[7]

The immediate **success control** of gamification also has a positive effect on learning. Often, the user is also shown the necessary time for the respective lesson. This gives him full control over how long he will need for the entire module. Rewardsystems such as rankings, status bars or medals also provide the user with immediate information about his success. In the best case, these systems motivate you to complete a module as well and quickly as possible, especially if you want to be as high as possible on the ranking.[8]

Better learning outcomes are ideally the result. 87% of respondents to a study by the website [9]talentlms.com said that learning is more effective thanks to gamification. This is because e-learning is interactive and therefore actions are better remembered than pure theory. Another reason why gamification achieves better learning outcomes was found by LMU Munich in a study with students. In this experiment, a hundred students assumed the role of warehouse workers. One half was trained in the classic way, the other half with the help of e-learning with playful elements. The result showed the positive effect. The second group was able to achieve significantly better results. The initiator of the study attributes this result to the fact that the perception of the tasks awakened by gamification had a personal significance for the participants. Therefore, these people are much more motivated to complete the tasks in the best possible way.[10]

Moving up the level, getting the most points or being at the top of the leaderboard are important aspects that **motivate** learners. Playful learning also motivates more than pure frontal teaching by a teacher. [11] With most game concepts, an exciting competition between the students is generated. This can create a further incentive to learn. [12] The motivation can be described by the use of gamification in the classroom, e.g. through the self-determination theory from motivational psychology. Deci and Ryan's[13] theory states that humans have three basic motivational needs. He needs the sense of competence, the sense of autonomy and the feeling of social inclusion. Figure 1 combines these basic needs with game-typical elements. A sense of competence can be achieved by constructing tasks in a meaningful way and adapting them to the abilities and possibilities of the learners. The levels should be challenging and demanding, but not overwhelming the students. The point of autonomy can be achieved through as many choices and solutions as possible. Social integration is achieved through partners or group work. This includes solving tasks together or interacting with others via leaderboards. [14] The effectiveness of the game-typical elements mentioned here has already been empirically well researched and substantiated.

[7] (Stöcklin, 2018)
[8] (Stöcklin, 2018)
[9] (Apostolopoulos, 2019)
[10] (Hoffmeyer, 2017)
[11] (Stöcklin, 2018)
[12] (Computer Science and Education, 2013)
[13] (Deci & Ryan, 1993)
[14] (Schedler, 2020)

	Ziel	Spieltypische Elemente
Psychologische Grundbedürfnisse befriedigen	Kompetenzgefühl fördern	Levels, Fortschrittsanzeige in Questtabelle, Rangliste
	Autonomiegefühl fördern	Eigenständige Quest-Auswahl, veränderbarer Avatar
	Soziale Eingebundenheit fördern	Avatare, Rangliste, Einteilung in zwei Gruppen

Figure 1: First part of the model of Stöcklin, Steinbach and Spannagel: Goals and measures to increase student engagement[15]

Another motivating factor is the flow state in which players sink during computer games. This mental state of complete immersion in a task and strong deepening is perceived as exhilarating. Through a suitable level of ambition, this flow experience can be promoted. The flow state can also be promoted by immediate feedback. Random searching or deliberate searching for random attacks, content surprises or various/hidden quests can promote the flow state.[16]

Important in order to arouse and maintain the motivation of the students is the **interest**. This can promote intrinsic motivation, including: through stories, dialogues, image and sound effects. Self-chosen tasks are selected according to the interest of the students.[17]

Failures are better processed by students in the virtual world. Here they have a secure virtual environment to test themselves. From the students' point of view, wrong answers are accepted here more loosely than in "normal" lessons. They are therefore more likely to dare to give it a try. Most people are used to not defeating a strong opponent in a computer game quickly. Setbacks provide incentives to do better.[18]

In times shaped by the Internet, computers and digital media, a playful learning design can be helpful in promoting the **independence** of the students, which is increasingly demanded by the outside world. Various researchers dealt with which skills/competences are important in the 21st century. [19] Henry Jenkins[20] of MIT and other authors listed eleven competencies. One skill is play, i.e. the ability to experiment with the environment, which is a form of problem solving. Secondly, the performance of adopting alternative identities for the purpose of improvisation and discovery is mentioned. Simulation, as a further ability to interpret and construct dynamic models of real-world processes, is added. The ability to dissect media content and produce something intimate from it is also part of competencea. Transmedia navigation, as the ability to follow the flow of stories and information across multiple modalities, is another competency. All these competencies listed here and all others correspond to skills that are also essential in many games .[21]

Likewise, the use of gamification in the classroom promotes **other competencies** in addition to the competence of independence , which are of decisive importance for the later working world of the students in a digital world. This corresponds to the approach of self-directedlearning and competence orientation. Own experience is central to the development of these skills. Thanks to the emotions experienced in the game, experiences can be better anchored in memory as experience. [22]

[15] (Stöcklin, 2018) (Schedler, 2020)
[16] (Schedler, 2020)
[17] (Schedler, 2020)
[18] (Hooks, 2021)
[19] (Stöcklin, 2018)
[20] (Clinton, Purushotma, Robison, & Weigl, 2006)
[21] (Stöcklin, 2018)
[22] (Stöcklin, 2018)

Gamification in the school context is also often used to increase student **engagement**. This also often leads to an improvement in students' academic performance. [23] More active discussions within the class and fewer rule violations and absences were also observed by teachers.[24]

Another advantage is the promotion of **media literacy**. [25] Students learn to use digital devices more confidently. Intuitive operating elements make it easier for learners to use. However, students are often confronted with programs that are not easy to use in their later working world. Therefore, a less intuitive gamification unit, by a non-tech-savvy teacher, is also a promising way to promote the problem-solving competence of students in this area.

DANGERS/DISADVANTAGES

Known dangers are that not the same **amount of learning material** can be taken through as in conventional lessons. This is particularly problematic with a tight curriculum. The **technical equipment** in classrooms can also lead to difficulties. A stable Internet connection and the necessary hardware must be available to all students. Learning outcomes are harder to assess.[26]

The **competitive nature** also has a negative side. Under certain circumstances, students may be tempted to "cheat" in order to be at the top of the rankings or to achieve good/better results. It is therefore questionable whether the successful completion of a game is to be equated with the solving of pureanalogous tasks.[27]

Gamification in the classroom can also easily lead to **digression**. This would be the case if the elements used deviate too far from the actual topic. Not every "game" is suitable for all ages. For older students, this can often be too "childish." Younger students may also overdo it with the playful atmosphere.[28]

In a reaction to a Classcraft video, Rackwitz explains that unfortunately, the **short-term effectiveness** of new approaches such as gamification in the classroom is often confused with the real reason for the fascination in the game. A monotonous game is still monotonous. No game is played only because there are reward points, but because it is varied and interesting for the players. There is also criticism that gamification approaches often concentrate entirely on "wrong" instruments. It just creates a souped-up reward system. [29] Gamification also requires a high degree of personal responsibility. [30] The use of gamification is a purely **extrinsic motivation** via rewards. This carries the risk that with more frequent use, this motivation will quickly wear off.[31]

Data protection regulations must also be observed. Real names, student behavior, results, goals, and other sensitive data must be protected. [32] In particular, the strict data protection laws of the respective countries and school authorities must be strictly adhered to.

A big critic of gamification is Ian Bogost. His criticism is, "Gamification is bullshit". More precisely, he means **"dishonesty".** He criticises the fact that only points are added to an existing system and that thise is then titled as game-like. According to Bogost, however, this does not change the system and consequently nothing more pleasurable or game-like. [33] Mag aret Robertson, also a game designer, also complains that most gamification projects only take points and badges from games and completely ignore the complex

[23] (Stöcklin, 2018)
[24] (Sheldon, 2012)
[25] (Cornelsen, 2018)
[26] (Computer Science and Education, 2013)
[27] (Computer Science and Education, 2013)
[28] (Computer Science and Education, 2013)
[29] (AK "Lernförderliche Gestaltung digitaler Medien fü, 2021)
[30] (Stöcklin, 2018)
[31] (Hooks, 2021)
[32] (Stöcklin, 2018)
[33] (Bogost, 2011)

mechanisms that would open up exciting choices. She also misses the possibility of failure or success in most projects.[34]

It should also be borne in mind that the positive experiences received so far in studies and experiments must be put into perspective, as they have usually worked with a lot of passion through teachers who have carried out these experiments. Therefore, the expected added value of gamification should always be considered in this context. [35] The **commitment of the teacher** should therefore play an important role in the successful use of gamification in the school context.

The expectation that gamification of lessons will be as **much fun as a game** cannot be assumed or expected either. Two factors that speak against it are that working with the gamified teaching unit is usually not voluntary. It is part of the teaching aimed at conveying a specific curriculum content. This content is then queried in a learning objective control. Thus, it is obligatory for the students to develop this gamified teaching unit[36]. However, Mollick and Rothbard[37] have found in a study on improving the work performance of gamblers who are obliged to participate in a gamified system that the disadvantage described is less significant for this group of people than for non-gamblers. Persons. The second factor to consider is that a gamified lesson is not exclusively for entertainment, but, as already described above, has a serious goal and pursues the learning of a subject area. Hansen[38] comments on this as follows: If a learning unit is too fun, it is easily suspected of no longer being sufficiently instructive.

In order for extrinsic motivation, which arises from the game-typical elements described above, to shift in the direction of **intrinsic motivation**, certain peculiarities must be taken into account in the educational context. As discussed earlier, **quests** can give students a sense of autonomy, turning passive learning into active participation. However, this is only the case if the students can achieve this goal that the gamified learning unit specifies. If this is not the case, it should be possible to repeat the learning unit as often as desired without the errors being offset. [39] Stöcklin[40] goes on to explain that gamers as well as employees in the economy feel good in the evening when they arrive home with the feeling that they have made progress . According to O'Donavan,[41] this sense of progress is one of the most central motivations of all. Visualizing **progress bars** are thus one of the most effective game elements. [42] The feedback factor has also already been mentioned. Praise for performance can be highly motivating. However, caution should be exercised when it comes to praise directed directly at the person . According to Dweck, [43] this can also undermine self-confidence in the longer term. **XP's**, i.e. points for achievements, are a simple but powerful instrument to emphasize and prove the progress of the students. Likewise, students receive information about the extent to which tasks are important, or more precisely difficult, or rather not. As already mentioned, points are therefore not welcome by gamification critics, as they are often introduced into a non-playful context as the sole game-typical element . The same goes for **levels**. The need to achieve goals can be increased here by reaching increasingly difficult levels with more points. In the school context, however, this concept cannot always be adhered to due to the curriculum content, depending on the subject and topic, or only over a short time frame. [44] Not every topic area contains complex content that is suitable for gamified use. For this reason, it is important to select a suitable curriculum content that can meet the criterion of increasing the level of difficulty. **Badges** are another motivational factor used in gamification in the classroom. However, they must be used with caution, as they can have negative, or rather counterproductive, effects on students. [45] This is especially the case when a child receives hardly any badges for services rendered or receives only the

[34] (Robertson, 2010)
[35] (Stöcklin, 2018)
[36] (Stöcklin, 2018)
[37] (Mollick & Rothbard, 2014)
[38] (Hansen, 2010)
[39] (Simões, 2015)
[40] (Stöcklin, 2018)
[41] (O'Donovan, 2012)
[42] (Stöcklin, 2018)
[43] (Dweck, 1999)
[44] (Stöcklin, 2018)
[45] (Stöcklin, 2018)

"lowest" badges each time. The same demotivation can come from **rankings**. [46] If the ranking list is visible to all students, this can lead to even greater demotivation in weaker students, as their weakness is emphasized and visible to all classmates. However, it should be noted that even in normal, analogue school lessons, weaknesses of pupils are usually visible to everyone, but here they have the opportunity to withdraw somewhat through little commitment in class. This would not be the case if the rankings were disclosed.

With regard to storytelling, Reinmann argues that some psychologists even consider narratives and stories to be the central principle of memory or thinking in general, which would underpin the effectiveness of [47]**storytelling**. However, designing a good overarchingstory in the school context is a particular challenge. Firstly, stories lead to an extension of the task texts, which is likely to find particularly unappealing to students with reading difficulties. Secondly, the stories should appeal to as many students as possible, regardless of their interests. Since gamification should provide learners with as much choice as possible in the classroom, a purely linear processing of the task is not possible. Teachers should therefore develop a story with ramifications and paths that reunite in between or contain episodic story snippets that stand on their own, suggests Stöcklin.[48]

POTENTIALITIES

According to Roman Rackwitz, the following five points are important for the successfuluse of gamification. Clear **objectives** and **rules** must be established. All informationmust be **transparent** for the participants. Similarly, quick **feedback** on success/failure is particularly important here. There must be **freedom of choice**. In addition, the tasks must be **solvable** and offer a varied **challenge**.[49]

As mentioned earlier, pure extrinsic motivation can quickly wear off. Therefore, **reward systems** and rankings should not be **used as the sole means of motivation** . Students should have the freedom to develop their own ideas and solutions. Creativity, curiosity and joy of discovery should be the main incentives. It is therefore best to use secrets and riddles that the students can uncover or solve.[50]

The **competitive nature** of games, as listed in the benefits, can motivate students to learn more in order to be higher on the **leaderboard**. However, if a player loses more often, this can be very demotivating. In order to avoid this, it makes sense when using gamification in schools, if rankings are created, to delete them regularly by the teacher, so that everyone has a new chance. Another solution is the formation of teams. It should be noted that the teams are reassembled as often as possible. Also, solving with creative solutions should be in the foreground, not just the pure quick achievement of a solution.[51]

To build a gamified learning environment, Huang and Soma recommend[52] a **five-step concept**. Figure 2 briefly illustrates this concept. The target group belongs to the first stage. This includes age, current level of learning, game types, etc. In addition, the content belongs to this level. At this stage of conception, one should also deal with the aspects that could lead to failure. These can be obstacles such as lack of concentration, overconfidenceor distractions. The integration of the learning platform into the teaching/learning environment must also be considered. The second stage deals with learning objectives and competences. Motivation boosts between the learning levels should be planned. Levels of difficulty, time expenditure and the division into learning areas must be considered and planned. Stage three involves the development of gamification. This means, for example, the distribution of points and the setting of milestones. Immediate feedback to teachers and students would be built in and taken into account here. As a last stage, you should deal with the game design elements. These include badges, leaderboards, progress bars, and rewards. For the use of gamification in the classroom, the commitment and self-organization should be increased.[53]

[46] (Stöcklin, 2018)
[47] (Reinmann, 2006)
[48] (Stöcklin, 2018)
[49] (Hooks, 2021)
[50] (Hooks, 2021)
[51] (Hooks, 2021)
[52] (Huang & Soman, 2013)

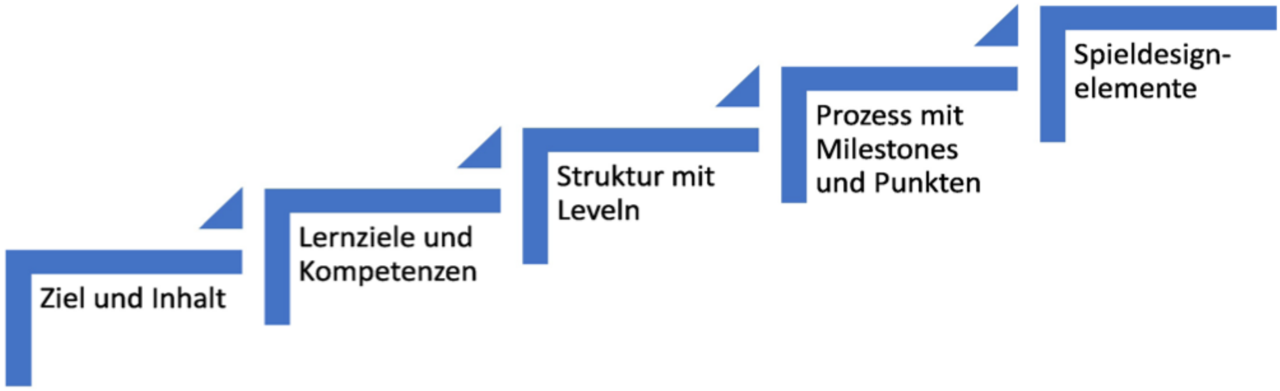

Figure 2: 5 stages of conception[54]

Schedler Marlis summarizes the important components for gamification in the classroom in a clear graphic (see Figure 3). The basic psychological needs already mentioned and implemented promote the feeling of competence, the feeling of autonomy and social integration, which are the first priority. As a second category, it is mentioned that flow-like moments should be generated. This state can be achieved by offering **manageable challenges**. Furthermore, immediate **feedback** contributes to achieving this state among the students. This leads to the fact that security is gained with regard to one's own competences. [55] There is a lot of scientific evidence that has researched the effectiveness of feedback. [56] An ideal constellation between **personal interest** and the chosen topic area can also lead to a flow experience. Random finding or active searching for **"hidden" game elements**, creative and stimulating tasks also generate this. Examples of this are random achievements or various types of quests. The third point listed by Schedler is the aspect "arousing interest". This can promote intrinsic motivation. Elements that can lead to the promotion of intrinsic motivation are a **storyline** or the use of avatars. Appealing graphics, image and sound effects or NPC dialogues are also part of it. The **identification with the game** is increased by the fact that the students are involved in the storyline. Studies show that gamification can lead to anincrease in performance . Especially a combination of performance-relevant feedback, challenging goals and constructive competition are effective.

53 (Schedler, 2020)
54 (Schedler, 2020)
55 (Schedler, 2020)
56 (Kluger & DeNisi, 1996)

	Ziel	Spieltypische Elemente	
Psychologische Grundbedürfnisse befriedigen	Kompetenzgefühl fördern	Levels, Fortschrittsanzeige in Questtabelle, Rangliste	Deci & Ryan
	Autonomiegefühl fördern	Eigenständige Quest-Auswahl, veränderbarer Avatar	
	Soziale Eingebundenheit fördern	Avatare, Rangliste, Einteilung in zwei Gruppen	
Flow-ähnliche Momente generieren	Bewältigbare Herausforderungen anbieten	Quests, Ziele, Rangliste	Stöcklin, Steinbach & Spannagel
	Unmittelbare Rückmeldungen anbieten	Automatisch bewertete Quests	
	Nicht vorhersehbare Momente / Vielfalt anbieten	Zufalls-Achievements, inhaltliche Überraschungen, verschiedenartige Quests	
Interesse wecken	Neugier wecken	Storyline, Avatar	
	Fantasie anregen	Storyline, Grafiken, NPC-Dialoge	
	Identifikation erhöhen	Einbezug in Storyline, Avatar	

Figure 3: Model: Goals and measures to increase student engagement [57]

The following game elements could therefore be included in a school gamification system, taking into account the above. Interest in the students is aroused by introducing them **to a topic in a playful way**. Game tutorials can serve as role models for this. The **mutual support and help** between the students can be rewarded by awarding **support points**. **Player types** should be specifically differentiated in order to meet the conflicting interests of them and to activate as many students as possible. This can be achieved with tasks in which social exchange or competitive are in the foreground. **Mistakes** should not be punished. Trying a quest several times is the key to not focusing too much on mistakes and demotivating students. Making mistakes is part of learning. Successes achieved should be appreciated according to the achievement of academic performance.[58]

SUMMARY

Overall, it turns out that gamification can be a useful way to make lessons motivating for the students. Interest in the topic, a sense of competence and autonomy and social integration are promoted. Overcoming challenges with immediate feedback to learners increase motivation, stimulate imagination and increase identification with the lesson topic. However, it should be notedthat a detailed and easily communicable concept must be created. Game elements must be implemented and filled with meaningful content. The teacher needs a pronounced didactic competence and technical affinity in order to be able to implement the ideas. Particular attention should be paid to the time factor. In most cases, it is not very effective and very time-consuming if a teacher creates his own "games" on teaching topics, and then only uses them himself. It must also be noted that all the advantages, disadvantages, possibilities mentioned have not yet been sufficiently researched scientifically. Detailed studies on the field of gamification in the school system are

[57] (Schedler, 2020)
[58] (Stöcklin, 2018)

still too small to clearly affirm the positive aspects. So far, empirical surveys have mainly taken place at university level or in adult education. According to Stöcklin, a [59] categorization of gamification types is also missing for a differentiated analysis.

Taking into account the disadvantages, limitations, dangers, possibilities and advantages mentioned above, the use of gamification in the classroom represents a new motivating and performance-enhancing possibility. [60] Gamification should be able to be used specifically and increasingly in the classroom. Teachers need suggestions and support in order to be able to use high-quality games that have been developed by tech-savvy teachers and are available to the teaching staff. The advantages are obvious: time savings in lesson preparation, increased performance and joy in learning among the students. These are elements for successfuldigital teaching, which will become more and more important in the coming decades. The further development of "gamification in the classroom" can make an important didactic and content-related contribution to this.

Table of figures

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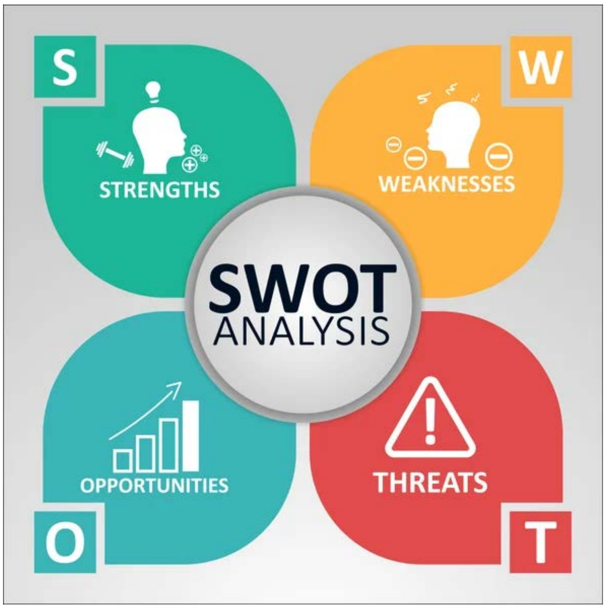
4.5 GREECE



Introduction to SWOT analysis

SWOT analysis is the best method to identify the strengths, opportunities, weaknesses and threats of a system always in relation to its environment. SWOT analysis is a method with multiple applications that was originally applied to businesses and presented their strengths, weaknesses as well as the opportunities and threats created in the environment in which they operate. The word SWOT is derived from the initials of the words: Strengths, Weaknesses, Opportunities and Threats. Strengths refer to what an organization does well, weaknesses to what it needs to improve, opportunities to what data it uses in order to achieve its goals, and threats to what obstacles it faces.

The ultimate goal of any SWOT analysis is to formulate the most ideal plan of action that makes the most of the system's strengths, taking advantage of the opportunities in its environment, while improving the system's weaknesses and preparing the system for threats posed by external factors. It has been described as an ideal method to design an effective strategic short-term program.

In recent years, the SWOT analysis has been applied not exclusively to businesses, but to any system that consists of human resources, has a structure, an institutional framework and is surrounded by an environment that is constantly changing and influencing itdynamically. The analysis in each case is used to plan the steps to achieve the goals that have been set.

The SWOT analysis in education

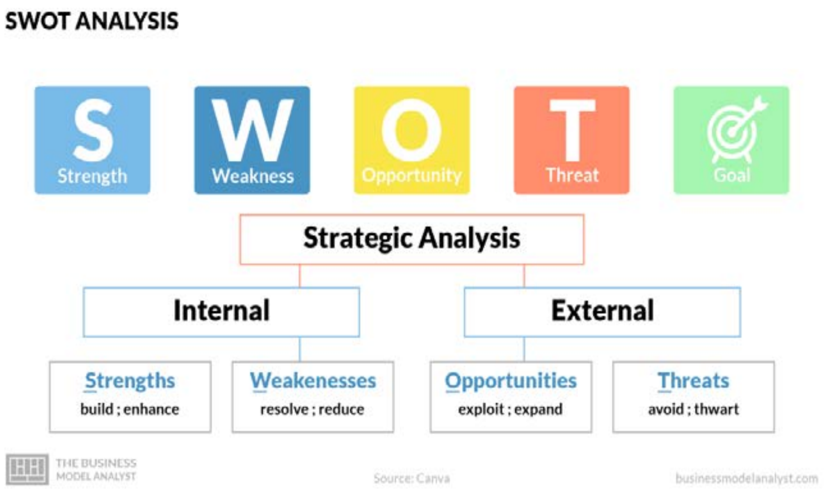
An educational organization is an open social system that interacts, interdepends and is influenced by the environment in which it operates. As in any dynamic system, so also in school units, the more unstable the environment, the greater the uncertainty in handling various situations. Economic, political and social changes on a global scale, as well as countless scientific and technological discoveries, affect the open system of education and require knowledge, flexibility, creativity and innovation from school units to be able to adapt to new environmental conditions and to develop self-regulatory mechanisms that will lead to new equilibrium states.

School units are open, interactive, dynamic organizations that are constantly changing. They have "customers" (parents, local community, etc.) who urgently demand efficiency, evaluation and accountability. They operate within a framework of competition aimed at achieving their goals and satisfying their needs with the resources they have.

Educational organizations, in order to successfully plan and implement teaching and extracurricular activities and practices, in order to respond to modern changes and challenges, should study their external and internal environment, using the appropriate assessment tools, such as SWOT analysis. The specific strategic planning tool is used when a decision has to be made in relation to the goals they have set (Paschalis, 2020).

The application of the SWOT analysis can and should find application at the micro level of the school organization because through it we can analyze the identity of the school, apart from the strengths, weaknesses, opportunities and threats. The SWOT analysis aims to identify and highlight the weaknesses and deficiencies in resources, materials and human resources that act as a hindrance to the development of the organization. In order to function properly, both administratively and at the learning and pedagogic level, the school unit must assess all the internal and external factors that affect its operation in a positive or negative way. In the education system the SWOT analysis has been introduced and successfully applied, as the educational systems of every society are consisted by individual school units. Each of them is consisted by a large number of people, students, teachers, education officials, who operate with a specific structure and legislation drawn up by the respective political leadership and have buildings with a specific layout and infrastructure~~.~~ At the same time, each school unit is dynamically influenced by the whole society.

Therefore, the SWOT analysis is a useful and necessary tool for investigating the needs and the environment of educational organizations, while it is the first and most basic step of the strategic planning of school units. Despite the centralization and rigidity of central administration, this planning is vital for every school. SWOT analysis helps school units to anticipate and deal with the fluctuations, changes, uncertainty and ambiguity of the environment in order to effectively meet their goals. The conclusions of the analysis help each school organization to build on its strengths, identify and overcome any weaknesses, take advantage of opportunities and challenges and effectively manage any threats. The assessment of the four elements (strengths, weaknesses, opportunities, threats) will enable each school unit to maximize its efficiency and effectiveness and improve the quality of the services provided by designing specific and targeted interventions (Paschalis, 2020)).



In this chapter we will attempt a SWOT analysis for the education system of Greece in relation to STEM and gamification. From the previouschapters it has been clearly demonstrated that theclarity of STEM and gamification in modern education is highly necessary, all that remains is to gain a better awareness of the strengths of the educational system that will be to make good use of it, to highlight the opportunities presented, but also to make the weaknesses ~~are~~ clear in order to formulate the steps to improve or eliminate them and finally to perceive the threats presented by the environment in order to be prepared to face them. The SWOT analysis gathers data from the infrastructure of the school units, the thorough educational program and the educational system of the country as well as the capabilities of the educational staff.

The educational system of Greece has a centralized and traditional character, which delayed the implementation of this strategic planning at the school unit level. The use of the SWOT analysis tool is relatively recent and was created in response to the increase in environmental uncertainty and the need for greater efficiency and accountability (Paschalis, 2020). Law 4547/2018 (Government Gazette 102/A/12-6-2018) and in particular article 47 "Planning and evaluation of the educational work of school units" introduces for the first time the concept of planning at the level of educational organizations and gives the opportunity to the teachers' associations to plan actions and procedures to improve the educational work within the framework of their responsibilities. The recently passed law 4692/2020 (Government Gazette 111/A/12-6-2020) and in particular article 33 "Collective planning of educational work and groups of professional development actions" takes one step further and now establishes the process of planning at school level unit, giving the teachers' association and the coordinator of the educational project, who is pedagogically responsible for the school unit, the freedom to freely choose any areas of the unit's operation that they think should plan actions. In other words, the latest law expands the areas in which interventions can be planned, taking into account of course the final assessment report of the school, in terms of its educational work, of the previous school year as well as the current needs of the organization. Law 4692/2020 (Government Gazette 111/A/12-6-2020) can and should be the means to decentralize our education system and to strengthen the autonomy of the school unit with more flexible structures and with less guidance from the central authority (Hatzipanagiotou, 2003).

It is now widely accepted that, despite the centralization of the Greek education system, long-term strategic planning at school unit level using innovative tools such as SWOT analysis enables schools to make better decisions, taking into account opportunities and environmental threats as well as their strengths and weaknesses.

SWOT Analysis for STEM

SWOT analysis can contribute to the optimization of STEM teaching in the school unit with a long-term horizon. Through this analysis, the school unit determines its objectives and determines the ways in which they will be achieved. The objectives must be measurable, realistic and in line with the real capabilities of the organization. This strategic planning defines the content of the actions to be carried out and describes the route to be followed to implement the stages.

In the context of the school unit, the strategic objectives must follow the framework of the objectives determined by the central administration and the limitations it sets.

STRENGTHS

- There are computer, physics and chemistry laboratories that can be used.
- Every school has an internet connection.
- There are ministry-approved educational programs for STEM that can be implemented within the lessons.
- In 2021, ‘skills workshops’ were legislated for middle schools and in 2022 ‘groups’ for high schools, within which there is the possibility to develop STEM programs.

OPPORTUNITIES

It is a vital issue to involve students more and more systematically in STEM activities in education, whether in the context of formal education or outside the school environment. It is necessary to adopt new teaching methods and favor the use of innovative tools that effectively serve to cultivate a positive climate for the development of modern skills. These are necessary not only for the individual's success in the professional field but also for his successful functioning as a unit in his life and in the interaction with his social environment (Katsavou, 2017).

Research from the National Science Foundation shows that through good practices in STEM education, students in all school types can engage in high-quality learning in science, technology, engineering and mathematics. One of the issues that arise during this process is the search and securing of the conditions that will allow the active involvement of more students in STEM education.

With the main goal of attracting students' interest, so that they get involved in STEM activities with enthusiasm and not out of obligation, we identify the following opportunities in Greek schools:

Free STEM courses are offered for teachers and support environment for students from various platforms. For example, the Generation Next program includes students from all over Greece and has reached approximately 92,000 beneficiaries, while 535 innovative projects have been created by student groups in 119 regions throughout Greece. In these programs students deepen their knowledge of science, technology and mathematics through games, experiential activities, experiments and constructions.

They discover knowledge, acquire skills in handling tools, programming, problem solving and learn to work together.

- Almost all students have smart phones.
- Students have a very good relationship with technology. Almost all students have a computer at home and are quite capable in using it.
- Some of the students and teachers know programming and have taken STEM courses on their own initiative. Students believe that their involvement in STEM courses helped them improve their computer skills, and correspondingly that their familiarity and knowledge of computers and programming helped them improve their STEM skills.
- Students find STEM very interesting and some do it in their spare time. STEM education is a process that is still in its infancy in Greece, but is rapidly spreading and developing. More and more agencies, schools, teachers, parents and students are interested in this type of education, seeing the positive results of those who participate.
- Students combine STEM with their professional and academic plans according to an OECD study. According to Tzimogiannis (2019) historically, the social purpose of education is for people to acquire the skills necessary to achieve two important goals: a) professional success and recognition and b) social integration and mobility.
- According to an OECD study, students derive pleasure from activities related to natural sciences.
- A key feature of STEM programs is problem solving and innovation, which we find as an innate tendency of students.
- There is already material for STEM applications, free on the internet that can also be used in school.

WEAKNESSES

STEM education is at an embryonic stage in Greece, especially in the critical regions, such as Rhodes. Few children have experience in STEM programs and most students rarely experience student-centered teaching approaches in their daily school life.

- Not every school necessarily has teachers who have knowledge and certification in STEM teaching. It is a fact that in Greece there are many professors who teach Natural Sciences, Technology, Informatics, Engineering and Mathematics, but there are very few who can combine the interdisciplinary teaching of these subjects.
- The computer labs have an average of 20 computers, which are used for computer lessons during most school hours. In order to achieve the goals of the Analytical Curriculum and the Middle School and General High School Informatics Curriculums, the school's Informatics laboratories are primarily used for the teaching of computer science courses and are rarely available for the teaching of other subjects.
- There is strict legislation regarding the use of mobile phones by students. Specifically, according to the current Greek legislation, students are not allowed

to have in their possession, inside the school, mobile phones or any electronic device.

There is too much material that must be taught during the school year in most courses that makes it prohibitive to differentiate from the teacher-centered approach. The Greek educational system treats the cognitive content as a given, which the students must learn. Thus, students do not connect knowledge with everyday life issues and their misconceptions continue to exist and be reinforced. Also, they cannot understand in depth the theories and laws of natural sciences because they are not familiar with scientific language.

The material provided for STEM programs in Greek is minimal. In Greece, some efforts have been made in recent years to develop STEM educational programs, mainly with the entry of educational robotics into public and private schools and tutoring centers. The way that has mainly qualified for the dissemination of STEM through educational robotics activities is the organization and participation in pan-Hellenic and not only competitions. For this participation, in most cases, the support of important sponsors is necessary for the provision of the necessary equipment and the partial training of several trainers in the correct use of these systems.

- On the part of the Ministry of Education, while the encouragement is given through instructions and seminars to include STEM in the teaching, the corresponding equipment is not provided to the schools, which is usually acquired at the own expense of the teachers or parents or through sponsorships.
- The curriculum does not provide the necessary time to plan and implement STEM activities in the Greek school. The curriculum is stressful and the assessment method is strictly standardized, eg written exams, pan-Hellenic exams for access to higher education, etc. Consequently, in most cases STEM activities are implemented exclusively in the context of extra-curricular school activity programs, skills workshops and groups.
- Digital tools have not been widely integrated in schools. A significant percentage of teachers refuse to use new technology in the classroom, either due to lack of training and fear, or because they consider the traditional, teacher-centered way of teaching to be better.
- In the PISA competition, which is considered a benchmark for education systems on a global scale, Greece was ranked in Natural Sciences and Mathematics in the group of countries with the lowest performance than the OECD average and with a statistically significant difference. According to the most recent PISA competition in mathematics, 66.5% of primary school students in Greece had correct answers, while the corresponding percentage in high school is 45.4%.
- You do not offer time and opportunity to all teachers for relevant retraining.

THREATS

It is undoubtedly imperative to abandon the current type of education, especially in an era where technology plays an important role and has decisively invaded the life of modern man. Possession of knowledge cannot be the only achievement of the educational process. STEM education requires an interdisciplinary, interdisciplinary approach as well as the development of internal elements (collaboration, critical thinking, acceptance of otherness, etc.) which are perhaps the only elements capable of strengthening the cognitive horizons of teachers and students and shaping a field with ever new challenges and possibilities, which will increasingly spur the mood for learning.

- The speed with which technological changes are made, lead to rapid obsolescence of the equipment and also the know-how required for STEM.
- Many parents consider engaging in STEM as a waste of time for students, since they believe that the sole purpose of school is to get students into higher education.
- The cost of acquiring and maintaining the necessary equipment is relatively high and is often borne by the students themselves and their families, thus acting as a deterrent to participation in STEM programs.
- Even when the cost of acquiring and maintaining the necessary equipment is covered by sponsors, the programs are interrupted when the sponsorship ceases, since no sponsorship continues indefinitely.

Positive Internal	**Negative Internal**
• IT laboratories • Physics laboratories • Chemistry laboratories • Ability to join skills workshops and groups • Approved programs	• Limited or no equipment at all • The teachers as a whole have not been retrained • Prohibition of cell phones in school • Large volume of teaching material in each course • Low student performance in mathematics • There are no suitable conditions for the retraining of teacher
• Free educational material • Free lessons for teachers • Free lessons for students • The students' interest • The students' innate abilities • The cellphones	• Rapid obsolescence of relevant knowledge and infrastructure • The negative impression of the parents
Positive External	**Negative External**

Conclusions from the SWOT analysis

There is no doubt about the need for immediate integration of STEM in Greek schools. The STEM programs come to complement and update the curricula as, in addition to the knowledge they offer, they also develop the so-called 21st century abilities and skills, critical thinking, creativity, cooperation, communication, adaptability and observation.

We can create a short-term action plan that will build on the strengths we have identified, take advantage of the opportunities in our environment at this particular time, improve the weaknesses and prepare for the threats.

The short-term action plan will include the following steps:

1. Initially, the correct briefing of teachers, parents as well as the entire student community about STEM, its value and its prospects is the cornerstone of the action.
2. Organization of training programs for all teachers
3. Creation of a bank of STEM scenarios applicable to all subjects, while reshaping the course outline.
4. The legislation should be revised in order to include mobile phones in the teaching process and to give space and time to students to present their relevant knowledge and enrich it.
5. Setting up spaces for students to implement the STEM scenarios
6. Configuration of the Analytical Study Program and the Clock Program so that systematic STEM education and the implementation of the scenarios in various subjects are possible.
7. Finally, stable funding for the acquisition and maintenance of the necessary equipment and the configuration of the corresponding laboratory spaces should be ensured. The existing infrastructures should be strengthened and consumable materials should be available in sufficient quantities in the schools, following relevant annual planning and a relevant request from the management of each school.

An important role can be given to organizations already engaged in STEM teaching, as they possess knowledge and experience. With the right to enter the schools, the relevant certified entities will be able to be called by the teachers to support them in their work.

SWOT Analysis for GAMIFICATION

In the modern digital age, where electronic games are one of the most basic forms of entertainment, students of all levels respond positively to the use of these games in their daily activities. The educational community trying to harness new approaches to activate students' interest in learning has turned to these mechanisms trying to exploit them to make schoolwork more fun and, consequently, more effective. During gamification, learning techniques that include game mechanisms are applied in teaching to knowledge objects that are not intended for play. The game is used as a tool to activate the interest and enhance the interaction of the students with each other and with the teaching content.

Gamification often makes use of video games, although this is not the norm. Several educators have incorporated the mechanics and elements of electronic games into the learning process in an effort to capitalize on young people's familiarity with digital technologies. In recent years, many educational applications have been designed based on this new philosophy. Gamification is the use of game mechanics and elements such as scores, prizes, contests and challenges in activities that are not directly related to them, but are aimed at enhancing the learning experience. These elements, if properly utilized in the educational process, can dramatically increase students' interest and engagement and achieve optimal learning results (Yovanopoulou & co., 2018).

STRENGTHS

"One learns more in an hour of play than in an hour of discussion," Plato.

- There are IT laboratories that can be used.
- Every school has an internet connection. Recent studies have shown that in the European Union, 74% of young people use the internet on a daily basis when they are at home, and only 21% use the internet at school. For a child who has integrated technology into his daily life, a classroom that does not keep up with these technological advances is boring and old-fashioned.
- There are educational programs for creating games.
- In 2021, the «skills workshops» for middle schools and in 2022 the «groups» for high schools were legislated, within which there is the possibility to develop games.
- Gamification can be applied to any subject, turning any boring content into an enjoyable process, thus giving strong motivation to learn for students. Gamification is not directly related to knowledge and skills. But it motivates and reinforces behaviors that can lead to the acquisition of knowledge and skills.
- Gamification in any subject reduces stress and increases students' emotional engagement in the activities, since it activates intrinsic learning motivation.
- The pleasant feeling offered by game elements during the learning process contributes to the improvement of learning results.
- Teachers involved with gamification techniques become more energetic, more student-centered and adopt active and experiential learning techniques, avoiding lecture and ready-made solutions. Many teachers realize in practice that this role suits them better, since it gives them more enjoyment and therefore a greater desire to teach.

WEAKNESSES

- In Greek schools there are no teachers with certification for creating games.
- Most teachers lack training and familiarity with the relevant tools. This lack of familiarity creates the perception that gamification does not fit as an approach to the subject they are teaching.
- The computer labs have an average of 20 computers, which are used for computer lessons during most school hours.
- There is strict legislation regarding the use of mobile phones by students. Specifically, according to the current Greek legislation, students are not allowed to have in their possession, inside the school, mobile phones or any electronic device.
- There is increased material in most courses that makes it prohibitive to differentiate from the teacher-centered approach.
- There are no games in Greek with exclusively educational content.
- The lack of suitable software for various learning objects, mainly due to their high purchase cost.
- Gamification cannot meet the learning needs and interests of all students. For this reason, the continuous training of teachers in its use is necessary.

OPPORTUNITIES

- Almost all students have smart phones.

- The students show an impressive familiarity with games in electronic environments, which is why it is rightly called the "gamer generation".
- Using gamification elements such as competition, achievement levels, feedback and scoring enhances student motivation and engagement.
- Some of the students and teachers know how to design games on their own initiative.
- Globally gaming is popular among youth as a leisure activity. In particular, gaming tends to be recognized as a sport and worldwide championships are organized with huge participation.
- Familiarity with English is proof of the effectiveness of gamification
- There is free software for creating games
- There are free game-making tutorials online.
- There is an absolutely positive attitude of students towards video games.
- In most subjects it is possible to use only the mechanisms and elements that govern the games and not the games themselves as an entity or software, thus saving significant resources for purchasing hardware equipment.

THREATS

- Many parents as well as teachers consider playing games as an occupation with no benefit for the students.
- Students as players focus on the goal of completing the game instead of using it as a learning tool and thus become distracted from the learning process.
- Excessive use of electronic games can lead to low self-esteem and aggressive attitudes and behaviors, such as gambling.
- There is a great deal of fear from parents and students about possible video game addiction.
- In some groups of students, gamification could lead to addiction or overexertion. Especially at young ages where children do not have the ability to manage time properly combined with the obsession to reach some desired level, gamification could distract students from achieving the essential goal to which the learning process aims.
- Spending too much time playing electronic games can cause physical symptoms, such as joint pain and headaches.
- For some students it confuses reality with virtual reality making them feel like they are living in a virtual world in which the story of the game/gamification activity unfolds.

Positive Internal	Negative Internal
• IT laboratories • Ability to join skills workshops and groups • Free programs for creating games	• Limited or no equipment at all • The teachers as a whole have not been retrained • Prohibition of cell phones in school • Large volume of teaching material in each course • There are no suitable conditions for the retraining of teachers

	• There is no game with educational content in Greek
• Free software • Free lessons for teachers • Free lessons for students • The students' interest • The students' innate abilities	• The negative impression of the parents • The fear of addiction
Positive External	**Negative External**

Conclusions from the SWOT analysis

The computer game industry has now become larger than the global music and film industries. The influence of computer games on today's youth is similar to that of the cultural influence of music, political movements and even religion on the youth culture of the past. Lately, computer games are attracting people wide range of people with different backgrounds to use computers. They have led to the spread of computers into the lives of people who previously had no incentive to use them.

Computer games gain unprecedented access to the homes, minds and souls of people today. Therefore, it has become increasingly important for game developers and educators to study the application of computers to improve the education offered to the next generation of students. Computer games can be used to give a better form of education and can even make computers become the only learning tools.

We can create a short-term action plan that will build on the strengths we have identified, take advantage of the opportunities in our environment at this particular time, improve the weaknesses and prepare for the threats.

Initially, the correct information of teachers and parents as well as the entire student community about gamification, its value and its prospects is the cornerstone of the action. Organization of retraining programs for all teachers and creation of games applicable to all subjects, while reshaping the syllabi. The legislation should be revised in order to include mobile phones in the teaching process and to give space and time to students to present their relevant knowledge and enrich it.

An important role can be given to organizations that are already involved in gamification, as they possess knowledge and experience. With the right to enter the schools, the relevant certified bodies will be able to be called by the teachers to support them in their work. Finally, the relevant infrastructures should be strengthened.

In order to introduce gamification into the educational process, the following axes must be implemented:

• Educational design: The needs of learners and teachers, the pedagogical framework and the educational model and strategies for creating educational materials are studied.

- Selection of teaching strategy: In order to choose the educational strategy to be followed, the learning objectives that have been set must be taken into account. The methodology of creating and utilizing the educational material depends on the teaching approach to be followed. That teaching approach may have as its starting point the teacher, the student or groups of students. Applying the game in education should avoid the traditional method of teaching, where the teacher organizes and chooses the teaching interaction, the way of learning and the way of evaluating the students and the students are passive receivers of the teaching. It will follow student-centered learning where the focus is on the student, rather than others involved in the educational process, such as teachers and users of various systems.
- Creating a schedule: this takes into account the time constraints placed on the learning activity. It is possible that some learning activities may need to be replicated outside the classroom by students. Extra-curricular and co-curricular activities can feed back teaching with valuable material and significantly improve the learning process.

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4.6. ITALY.

1.National level

Strengths

Several efforts by the educational institutions in the promotion of innovative teaching methodologies for the strengthening of STEM disciplines have been made in the past years. Recently, for example, the Italian Ministry of Education (MIUR) has called for the creation of workshops and the provision of digital tools to support learning and teaching of STEM subjects, in particular in the framework of Action #4 “Environments for integrated digital education” envisaged by the National Plan for Digital Education (Piano Nazionale Scuola Digitale - PNSD). This attention, also materialized in initiatives such as the National Digital School Award, created to enhance the experiences of individual schools in terms of educational innovation, has led to an increase in initiatives aimed at introducing the game-based learning method for the disciplines of STEM area.

The commitment to introduce innovative teaching methodologies such as Gamification and Game-based learning for the promotion of STEM disciplines is unthinkable without a general rethinking of educational spaces in order to favor an osmosis between the places assigned to education and favor a workshop-based teaching. In this sense, a recorded positive fact is greater attention, within the theme of the construction of school buildings, to the design of so-called ‘innovative schools’, through a series of ideas and design competitions promoted by the Ministry of Education in concert with the Ministry of Cultural Heritage to design, create and disseminate as model school buildings designed to encourage active learning also in the organization of spaces[1].

An initiative that goes in the direction of an implementation not only of enrollments in scientific degrees, but also and above all of a greater awareness on the part of students and teachers of the importance of a laboratory approach to the study of these disciplines is represented from the Scientific Degree Plan (PLS)[2], established in 2004 on the initiative of the MIUR, the Conference of Deans of Science and Technology and Confindustria, is a national intervention plan which aims to:

- promote enrollments in scientific degree courses, favoring a gender balance[3];
- reduce dropouts and improve student careers;
- carry out training, support and monitoring initiatives;
- carry out self-assessment activities for upper secondary school students to verify their readiness to enter universities;
- provide teachers of scientific disciplines with opportunities for professional growth through active participation in the planning of activities carried out jointly with the University;

The "PLS methodology" proposes that students, in orientation activities, and teachers, in training activities, play an active role through the proposal of laboratory experiences, in order to acquire a methodology that brings students closer to scientific disciplines through an experimental approach.

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[1] *Architettura dell'educazione*, a cura di E. Dorato, premessa a cura del Ministro dell'Istruzione, Prof. Patrizio Bianchi, I “Quaderni di MCA – Mario Cucinella Architects, Maggioli Editore, 2021.

[2] https://www.pianolaureescientifiche.it

[3] Also in the STEM disciplines in Italy there is the problem of the gender gap, with a clear prevalence, among the graduates of the male component, which reaches 59.0%, while the trend is reversed substantially in non-stem disciplines where there is a clear prevalence of female members (about two thirds of the total). Among STEM graduates, the male component is very high in particular among the engineering (74.0%) and scientific groups (68.4%), while the geo-biological, chemical-pharmaceutical and architecture groups record an equivalent or higher presence of women.

The laboratory activities are designed and implemented jointly by the teachers of the School and the University, thus strengthening the bond that unites or should unite the School and the University. The PLS therefore proposes an accompaniment of the student who wants to successfully undertake university studies in the scientific field starting from secondary schools. The PLS activities carried out at all university sites are developed according to the PLS Guidelines in the context of six actions:

- ACTION 1 – Enrollment guidance, promoting gender balance
- ACTION 2 – Reducing dropout rates
- ACTION 3 - Training, support and monitoring of tutors' activities
- ACTION 4 - Laboratories for teaching basic sciences
- ACTION 5 – Self-assessment teaching activities
- ACTION 6 – Teacher training

Weaknesses

The Invalsi (National Institute for the Evaluation of the Education and Training System) 2022 report[4] highlights a situation of difficulty and imbalance in the acquisition of skills related, as regards the STEM field, to Mathematics, but this data could be the index of a more general problem related to learning of scientific and technological disciplines *tout court*.

Starting from the last year of primary school, it is possible to notice how only 66% of students reach a level equal to or higher than the basic one, a figure that is worse than the previous two years.

There are profound differences between one region and another, but in general there is an increase in the number of students experiencing difficulties in this discipline, particularly in some territories (Campania, Puglia, Calabria, Sicily, Sardinia) where the percentage is very highest.

Furthermore, in Calabria and Sicily there are results that are distant, negative, from the national average, which is a phenomenon that gives rise to great concern.

Also with regard to lower secondary school, the southern regions are at considerably lower levels, not only in terms of overall results, but also in terms of the number of excellent pupils.

Campania, Calabria and Sicily, in particular, present a worrying picture, since students who at the end of upper secondary school reach the threshold of acceptability are around 60%.

As regards upper secondary school, the data allow us to see that substantially, most of the Italian regions reach level 3 as an average result, corresponding to the essential level, but there are some exceptions, including precisely Campania, Calabria, Sicily and Sardinia, where the average result stops at level 2, therefore below the minimum threshold expected after 10 years of school.

Furthermore, important differences persist between the various school streams, so that high school students in general are at a higher level than students from technical and vocational institutes.

There is therefore a problem of disparity throughout the national territory, which manifests itself in a difference in results in relation to gender, between North and South and between different fields, even in the case of studying an identical discipline, as in the case of mathematics.

The main factors affecting this disparity can be summarized as follows:

[4] Available here:

https://invalsiareaprove.cineca.it/docs/2022/Rilevazioni_Nazionali/Rapporto/Rapporto_Prove_INVALSI_2022.pdf

- *Gender*: already at the end of primary school, a difference can be detected in results against girls compared to boys. There is therefore a gender gap in mathematics which in Italy assumes more worrying proportions than in other European countries;

- *Background of origin*: students from more disadvantaged social backgrounds have a significant drop in academic performance;

- *Migratory background*: first and second generation foreign students achieve lower average results than the others, although second generation ones show an improvement compared to first generation ones;

- *Territory*: the INVALSI Tests report shows that even where there are no other factors generally associated with a lower outcome such as those listed above (gender differences, regularity in studies and foreign origin), the territorial difference within Italy represents an element of strong disparity in the results obtained, to the advantage of the Centre-North and to the disadvantage of the South.

In this context, the introduction of innovative teaching methodologies that exploit the potential of Gamification could represent a solution to prevent the various types of dropout linked to STEM teaching.
In this regard, it must be admitted that another problematic aspect is the lack of specific training for teachers, both for single subjects and for interdisciplinary areas, which allows them to discover and share experiences of good practices and become familiar with the tools and the technologies available to facilitate the dissemination of innovative teaching methodologies. The obvious risk is that of leaving the possibility of inserting tools such as Gamification within the teaching process exclusively to the initiative and evaluation of the individual teacher. A correct use of these methodologies requires a careful effort of systematic integration within the teaching-educational plan of the teacher, in order to calibrate teaching in terms of long-term objectives, knowledge and skills. In fact, an extemporaneous approach does not allow for a coherent set up of an educational path that exploits Gamification in progressively increasing levels of commitment that lead students to acquire a more refined awareness of their own cognitive and metacognitive abilities; in addition to this, the risk is that of neutralizing the so-called novelty effect, since even an innovative methodology which initially received the favor of the students can lose its attractiveness if it is not renewed through a systematic planning action which avoids the same playful-didactic schemes.

Opportunities

- The demand for STEM graduates in the job market is very high, but the number of people who decide to attend a STEM course in Italy is still low. In fact, according to the STEM Observatory report “Rethink STE(A)M education - A sustainable future through scientific, technological and humanistic skills” promoted by Deloitte, 44% of companies have already had difficulty finding candidates with this type of training. This makes STEM disciplines particularly marketable in the workplace[5].Based on the data provided by Almalaurea in 2018[6], five years after graduation, the employment rate of STEM

[5] For further information see: https://www2.deloitte.com/content/dam/Deloitte/it/Documents/about-deloitte/2022_Osservatorio_STEM_FondazioneDeloitte.pdf

[6] https://www.almalaurea.it/sites/default/files/comunicati/2019/cs_almalaurea_lauree-stem_2019_0.pdf.

graduates is 89.3% overall (+4.1 percentage points compared to graduates non-STEM), with a higher employment value among male graduates. Specifically, the best employment opportunities concern STEM graduates from the economics-statistics (94.8%) and engineering (94.6%) groups; while the group with the lowest occupancy rate is the geo-biological one (78.5%).

- In terms of educational innovation, the experience of the so-called serious games and gamification is starting to spread outside the school world as well and this factor can represent an incentive for educational innovation within the school, in line with the most recent methodological acquisitions. In higher education levels, e.g. university, in science faculties, awareness of the potential of game-based learning to address the difficulty of delivering complex content, which would be difficult to deliver through traditional teaching, becomes more and more important. It is possible to take as eloquent proof of this process some experiments conducted within scientific faculties in Italy, which have recorded positive feedback from students[7].This could trigger a positive knock-on effect which, through teacher training channels, sensitizes lower education cycles to the potential of gamification, especially for STEM subjects.

Threats

It should be noted, however, that in Italy there is still some resistance to STEM among the student population. Although the number of students enrolling in STEM faculties after school has increased in recent years, it is still below the European average, particularly for women. This could indicate a lack of openness towards scientific and technical disciplines on the one hand and, on the other, the sign of the difficulty of intervening to strengthen the teaching of these disciplines through the use of an innovative teaching methodology.

On the other hand, the application of the methodology based on game-based learning to STEM disciplines requires the availability and accessibility, on the part of school structures and students, to the resources offered by digital. However, the problem of digital illiteracy even among the younger population is still against this goal. The so-called digital divide is in fact an obstacle to widespread access to the resources available on the web. The DESI (Digital Economy and Society Index) 2022 report[8] highlights the persistence of a gap between Italy and other European countries on the subject of digital access, despite the efforts made in recent years to comply with EU standards. This digital divide exists not only between Italy and other European countries, but also within the country, between rural and urbanized areas and between North and South, and there are still many Italian citizens who lack basic digital skills. This factor may be related to the low proportion of digital specialists and low enrollment and graduation rates in the ICT field, also having an important impact on the applicability of methodologies used by these media, such as game-based learning for the study of disciplines STEM.

Regional and district level (Calabria and Reggio Calabria)

Strengths

[7] See for an example: C. Dal Bon, C. Ferranti, C. Peggion, *Esperienze di gamification all'università con moodle: the organic game*, Atti del MoodleMoot Italia 2019, 245-250

[8] https://digital-strategy.ec.europa.eu/en/policies/desi

The schools of the Calabrian territory show an increasing attention towards the world of science and its applications, progressively making students aware of the career prospects that it is possible to embrace through the study of STEM disciplines.
This datum is not only evident from the increasing diffusion in the various schools of curvatures of the educational offer that introduce experiments in line with this intention (such as for example the robotics and automation courses or the biomedical curvatures within the high schools), but also from a specific attention on the level of training also testified by the action of some schools such as, just to give an example, the "Raffaele Piria" Institute of Reggio Calabria which, already a pole school for the National Network on Innovative Teaching Methodologies "SFIDA (education) 4.0 PIRIA" and Regional Center for the Digital School Award of the PNSD, from the SY 2021-22 has become a STEAM Pole for teacher training, with the aim of providing them with all the tools and innovative teaching methodologies functional to improve teaching-learning experience.
The cultural fabric has also benefited in recent years from the presence of structures and initiatives that have brought students closer to the scientific community. Among these, to name a few, the "Pythagoras" Planetarium, owned by the Metropolitan City of Reggio Calabria, inaugurated on 12 March 2004, which promotes activities regulated by the convention stipulated between the Metropolitan City of Reggio Calabria and the Italian Astronomical Society, among which:

- Training courses for teachers.
- Orientation courses for students.
- seminars and conferences
- teaching and laboratory experiences

An initiative that deserves to be mentioned is the Cosmos Festival, held every year in Reggio Calabria, aimed at promoting a dialogue between science, culture and society, through open workshops, public conferences, information gazebos, and debates. It involves research bodies, cultural institutions, businesses and citizens. As part of the Festival, the Cosmos Award for scientific dissemination is also promoted every year, which involves high school students in Italy and abroad in reading and evaluating popular science books, in such a way as to make known scientists and science popularizers who have worked hard to bring science closer to people. The prizes awarded concern the best popular science work published in Italian in the fields of Physics, Astronomy and Mathematics.[9]

Weaknesses
As previously highlighted, the Invalsi 2022 report highlights a situation of difficulty as regards the STEM field, in particular as regards Mathematics, by Calabrian students, who generally are placed, both in the case of primary school and of the second level of education, below the national average.
This datum, if on the one hand is in line with the trend that sees the South and the Islands reaching a lower level than the rest of Italy, in the case of Calabria becomes particularly serious since even compared to the South and the Islands the region is placed in a lower position for the lower results obtained and the lower number of excellence.

Opportunities
A stimulating factor for the study of STEM disciplines is represented by the presence of university poles in the Calabrian territory which offer the possibility of study paths relating to different types of

[9] https://premiocosmos.org

STEM disciplines and also represent territorial garrisons for the development of a positive environment to research in this area.
All the three universities present in Calabria, the "Magna Graecia" University of Catanzaro, the University of Calabria in Cosenza, the Mediterranean University of Reggio Calabria, welcome STEM disciplines within their teaching offer, and can therefore become privileged interlocutors of the schools in an attempt to cooperate together to increase and innovate the teaching of these disciplines and constitute an important outlet for the students of the Calabrian schools who want to undertake this type of university path without necessarily having to move away from their region of origin.
Below, the educational offer of the three universities in the field of STEM disciplines:

MAGNA GRAECIA UNIVERSITY (CZ)

School of medicine and surgery
Three-year degrees:
Computer and Biomedical Engineering

Master's degrees:
Biomedical engineering

School of Pharmacy
Degrees:
Biotechnology
Animal Production
Sciences and Technologies Cosmetic and Wellness Product Sciences and Technologies
Biological Sciences for the Environment

Master's Degrees:
Molecular Biotechnology for Personalized Medicine
Pharmacy
Biotechnology for the One Health Approach

UNIVERSITY OF CALABRIA (CS)

Engineering and technology area
Bachelor's Degrees:
Computer
Science Chemical
Engineering Civil
Engineering Construction-Architecture
Engineering Electronic
Engineering Management
Engineering Computer
Engineering Mechanical
Engineering Engineering for the Environment and Territory Safety
Science and Engineering of Materials

Master's degrees:
Artificial Intelligence and Computer Science

Chemical
Engineering Civil
Engineering Electronic
Engineering Energy
Engineering Management
Engineering Computer
Engineering Mechanical
Engineering Engineering for the Environment and Land Security
Robotics and Automation Engineering
Telecommunication Engineering: Smart Sensing, Computing and Networking

Area Science
Three-year degrees:
Biology
Chemistry
Conservation and Restoration of Cultural Heritage
Physics
Mathematics
Biological Sciences and Technologies
Geological
Sciences Natural and Environmental Sciences

Master's degrees:
Biodiversity and Natural Systems
Biology
Chemistry
Mathematics
Physics
Geological Sciences

MEDITERRANEAN UNIVERSITY (RC)

Department of Agriculture
year degrees:
Sciences and Technologies
Food Sciences and Technologies
Forestry and Environmental Sciences

Master's degrees:
Agricultural Sciences and Technologies
Food Sciences and Technologies
Forestry and Environmental Sciences

Department of Civil, Energy, Environmental and Materials Engineering (DICEAM)
Three-year degrees:
Civil and Environmental Engineering for sustainable development
Industrial Engineering

degrees:
Civil Engineering

Engineering for sustainable management of the environment and energy LM-30
Engineering for sustainable management of the environment and energy LM-35

Department of Architecture and Territory
Three-year degrees:
Construction and Territorial Techniques

Master's degrees:
Architecture

Department of Information, Infrastructure and Sustainable Energy Engineering (DIIES)

Degrees:
Computer, Electronics and Telecommunications Engineering

Master's degrees:
Electrical and Electronic Engineering
Electrical and Electronic Engineering
Computer and Telecommunications Systems Engineering

From the point of view of environmental resources, the University of Calabria offers in particular cutting-edge laboratories in the areas of enabling technologies. Starting from the 2007-2013 national planning, some Research Infrastructure (RI) projects have in fact been launched in the areas of materials and biomaterials technologies with the initiative Materials, Technologies and Advanced Research - MaTeRiA/STAR, in the area of technologies for environmental monitoring with the University project Integrated System of Laboratories for the Environment - SILA and in the agri-food sector by participating with some inter-departmental laboratories in the Regional Network for Agri-food Research.
The set of research laboratories of these RIs represents an important tool for training in the technical-scientific area. More in detail:

- the IR MaTeRiA/STAR, STAR - Southern Europe Thomson Back-Scattering Source for Applied Research, is a research infrastructure that offers advanced scientific investigation services in the fields of materials science; it is included in the European strategy for regionally based centers and exploits an advanced X-ray source for high-resolution imaging, even three-dimensional, for the study of materials ranging from the field of cultural heritage to biomedical.

- IR SILA is an integrated system of 17 laboratories and research infrastructures for the provision of scientific and technological services dedicated to the monitoring, control and protection of the environment, for the mitigation of natural risks, the characterization and treatment of pollutants, waste and waste and health protection. SILA carries out research activities on:

- hydrogeological risk analysis and mitigation;
- seismic risk analysis and mitigation;

- chemistry, technologies and processes for the characterisation, treatment and valorisation of pollutants, effluents and waste;
- biodiversity, ecosystems and human health in relation to the environment and natural and anthropic risks;
- marine environment: protection and valorisation of resources;
- services for monitoring, modeling and advanced sensors to support environmental issues.

Unical also participates in the Agri-food Research Network, established between the Calabrian universities and the Terina Foundation which promotes the sustainable development of agriculture and the agri-food chains of the Mediterranean area, with the two for the characterization and qualification of the products of the small and medium-sized agri-food companies: the QUASIORA laboratory (Quality, Safety and Origin of Food) and the LIPAC laboratory – (Laboratory of Food Process Engineering in Calabria).

Despite the substantial peripherality of the cities in which they are located, these universities have distinguished themselves in a particular way in the field of research associated with STEM area disciplines, giving the territory a non-secondary stimulus to the care of this fundamental aspect of citizen education.

The University of Calabria was one of 16 universities in Italy (one of 4 south of Rome) to obtain the "HR Excellence in Research" award, conferred by the European Commission as part of the Human Resources Strategy for Researchers initiative (HRS4R), aimed at bringing the conduct of an institution into line with the principles of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (C&C).

On 20 July 2022, however, the National Agency for the Evaluation of the University and Research System (ANVUR) made available the "Area Final Reports" and the "ANVUR Final Report" relating to the Evaluation of the Quality of Italian Research (VQR 2015 -2019), in which significant results were achieved by the Mediterranean University of Reggio Calabria in the Chemistry Area (CUN 03 area), in absolute first place in Italy and, among the Scientific Disciplinary Sectors, the ING-INF/02 sector - Electromagnetic Fields, ranked first in Italy with 100% of the research team's products rated as "excellent and relevant".

On October 10, 2022, a team of analysts from Stanford University also published the ranking of the most influential researchers in the world in terms of their scientific production. Out of about 140 Professors and Researchers active at the Mediterranea in the STEM and Economic disciplines, 27 are present in the 2021 ranking of the most cited researchers in all sectors of world research.

Threats

The major problem that the Calabrian regional context presents with regard to STEM disciplines is related to the more general problem of employment and the absence of jobs capable of absorbing the number of students who are trained by Calabrian universities. Despite the fact that STEM disciplines enjoy a privileged status at national and European level in terms of employment, most graduates in STEM disciplines in Calabrian universities are in fact forced to seek employment outside the region. This factor certainly represents an obstacle to the possibility of a positive impact on the territory of the training received within the regional institutions.

3. School level (IIS "P. Mazzone" of Roccella Ionica)

Strengths

The Institute of Higher Education “P. Mazzone” of Roccella Ionica due to the type of courses present within its training offer, is by vocation linked to the area of STEM subjects. In fact, the school has a scientific high school and an industrial technical institute, within which the STEM disciplines play a fundamental role.

The Liceo Scientifico offers training aimed at providing students with a global preparation that allows them to access university, through a particular in-depth study of scientific disciplines and the scientific method. Inside there are two addresses:

- Sorting high school
- High school of applied sciences (with a greater number of weekly hours dedicated to natural sciences and with the introduction of information technology as a curricular discipline)

The Istituto Tecnico Industriale provides highly qualified preparation on a scientific-technical level through a series of very varied courses which aim to train professionals in the various technological sectors and also prepare them for continuing their studies in the university environment. It contains the following addresses:

- Environmental Biotechnology
- Mechanics, Mechatronics and Energy
- Transport and Logistics
- Electronics and Electrical Engineering
- Chemistry, Materials, Biotechnology
- IT and Telecommunications

The school is equipped with a considerable number of laboratories including: 4 Chemistry laboratories, 3 Electrical engineering laboratories, 2 Physics laboratories, 3 Computer science laboratories, 4 Mechanical laboratories, 2 Science laboratories which make possible an experiential approach to the disciplines of STEM scope.

Over the years, the school has opened up to numerous initiatives for the enhancement of training in the STEM disciplines: the Scientific Degree Plan, dedicated thematic days (such as the Day of nutrition or the day dedicated to Women in science or the celebration of the Periodic Table Anniversary), participation in study carried out by the teachers of the disciplines in question and to national initiatives such as the European Researchers' Night.

The school has also always joined the initiatives, proposed at national or regional level, aimed at stimulating the study of STEM disciplines through healthy competition: the Astronomy Olympics, the Mathematical Games, the Chemistry games.

Weaknesses

A difficulty that teachers face in their daily teaching activity is that of coping with the ever greater and more serious shortcomings that students present at the end of the previous education cycles, especially in scientific disciplines in which an approach aridly mnemonic is often privileged instead of the acquisition of the fundamental logical-deductive skills which underlie the transversal learning of STEM area disciplines.

The institute is making a considerable effort in an attempt to provide students with quality preparation, also through laboratory teaching. However, despite the presence of laboratories and Multimedia Interactive Whiteboards in all classrooms allowing for dynamic activities and teaching capable of incorporating digital resources and educational technologies, it would be necessary to increase the tools within the single laboratories and the number of multimedia workstations available for teachers, currently not in sufficient numbers to guarantee the possibility for everyone to effectively organize work within working hours and within the school building.

Opportunity

The presence in the regional territory of university poles in which an important role is reserved for STEM disciplines (see previous paragraph), makes possible an interaction between the world of school education and the university environment which will in fact constitute one of the most natural for the students of the institute at the end of their schooling.

Threats

The territorial context in which the IIS Mazzone operates presents an economy mainly based on the primary and tertiary sector. There is a lack of an industrial fabric and of a network of companies able to effectively absorb graduate students and those who, enrolled after school in science or technology, would like to remain to work in Calabria. The presence of these realities would allow already in the phase of school study to create a fruitful osmosis that allows to imagine the study of STEM disciplines firmly anchored to the challenges and needs of the territory in which students live and work.

4.7. LITHUANIA

STEM education is one of the most modern ways of education. It combines the natural sciences, technology and engineering, arts and mathematics, linking them to the real world, to change and progress, to the goals of sustainable development, and to solutions to real-world problems. STEM education develops students' critical thinking and problem-solving skills.

The use of integral education in education can help to address the lack of student interest in science and other STEAM disciplines, and prepare the leaders of tomorrow. Based on data from the Lithuanian Employment Service and Lithuanian employment trends, and on the 2018 future projections, which have been successfully confirmed, the most in-demand occupations in 2019-2022 will be engineering, mechanical, electronics, electrical, civil, and information technology sector application developers, programmers and systems analysts.

The high-tech economy in the European Union was projected to grow at an average rate of 7.5%, but in Lithuania it is projected to grow at a much higher rate, to almost 16.5%. As technology is changing the needs of the labour market, the importance and perception of science, mathematics and technology has increased in particular in recent times, and the achievement and attractiveness of pupils in the sciences is a reflection of the strength of humanity and the growth of economies.

According to the data of the Lithuanian Employment Service in 2018, more than half of all job vacancies (almost 55%) are focused on skilled professionals, while according to the 2014 survey of Invest Lithuania, as many as 69% of Lithuanian employers have not been able to find the right skilled employees in the last three years. One of the reasons for this is the lack of popularity of STEM professions among young people, the lack of professional training and motivation to study STEM professions.

26% of companies in the engineering industry face a shortage of qualified professionals. This is due to the fact that only 5% of students participate in non-formal education etc. in STEM subjects, 55% of graduates consider the subjects they were most interested in at school when choosing a profession. Teachers of STEM subjects face a major challenge to make their lessons more engaging, more inclusive, more relevant to real-world problems and more interesting and meaningful for students. For the past five years, higher education institutions have been receiving fewer and fewer applicants to study STEM fields. The paradox is that only one in ten girls choose to study STEM subjects as a more masculine subject, when we should be breaking outdated stereotypes and getting more girls interested in them.

To change the situation for the better, school, regional and national education monitoring and educational research is being carried out, as well as curriculum development and coordination, informative consultancy, qualification development, and learning environment support, schools are being included in the Lithuanian STEM Schools Network, and national and international projects are being implemented, including STEM. Improving the achievement of pupils and the adoption of approved curricula focusing on the development and expansion of a wide range of competences are becoming a national priority and a key challenge.

Improving STEM education in Lithuania

A network of STEAM schools and open access centres have been set up in Lithuania to introduce students not only to the subtleties of these disciplines, but also to look at them in a creative and interdisciplinary way, by connecting the arts and design. Methodological centres are being set up in the cities of Vilnius, Kaunas and Klaipėda, while regional methodological centres are being set up in Alytus, Marijampolė, Panevėžys, Šiauliai, Tauragė, Telšiai, and Utena counties. Their standardised and specialised laboratories are different, each centre has a specific focus, and teachers and pupils have the opportunity to go to selected centres to carry out activities of interest to them, such as mechatronics, marine exploration, astrophysics, science or other subjects. The STEM Centres aim to complement the general education curriculum by creating modern and inspiring STEM learning environments, improving teachers' competences and qualifications, providing career guidance for students, promoting the achievements of STEM fields, and helping students to complete their matriculation work not only in their schools, but also in these centres, while also encouraging them to pursue a STEM education.

STEM school label

"The STEM School Mark is one of the projects that has made a breakthrough in STEAM. The project has developed the STEM School Mark portal, with the main aim of helping European schools to strengthen and improve the skills and interest of young Europeans in STEM subjects. The project not only provides schools with methodological support to engage pupils, teachers and other stakeholders in STEM activities, in the design and development of a STEM strategy, but also with the possibility to acquire the necessary tools to carry out the project activities. Seven intellectual products have been developed with open access on the STEM School Brand Portal.

Key elements have been selected to symbolise and reveal the STEM strategy, and criteria have been selected for each element to reflect and evaluate STEM activities. Schools use an online self-assessment tool, based on the 21 criteria provided, to help them define and assess their STEM activities. Based on the results of the evaluations, schools identify areas for improvement, as this tool helps to highlight them, while at the same time providing suggestions for an action plan and the necessary resources to implement the plan. The 7 main elements of the school evaluation are: teaching, staff professional development, communication, curriculum adaptation, school infrastructure, school leadership and culture, and evaluation. Each of these elements has a set of criteria defining its eligibility to a specific element level, so that if they are properly evaluated, a school can successfully implement STEM activities through the tool.

Any school wishing to assess its STEM strategy and be visible to other schools in Lithuania and around the world can sign up for the portal, as it is international. First, schools register on the portal, submit their case studies, good practices, share their experiences and learn from the experiences of other participants, evaluate them, apply them in their educational processes, participate in monthly surveys, submit evidence of their good STEM practices in the portal forums, submit their case studies and submit a questionnaire for their evaluation. After completing the necessary registration procedures, the school receives feedback on how strong these seven key elements are, if any of them need improvement, and recommendations on how to do so (a step-by-step guide to school self-assessment is also available on the Portal). A STEM school - beginner, advanced or experienced - is labelled according to the number of points it scores. Each badge can be upgraded and changed: if the badge is not awarded immediately, the assessment can be repeated three months later to try for it, or if the school already has a badge, it can move up to a higher badge category. Once a school has obtained the beginner badge, it can move up a year later, and for experienced schools it is valid for 18 months.

Experience

The number of schools that have registered on the STEM School Label portal is high: one hundred and seventeen schools have done so in the eleven months of the project's activity, and 35 have already been awarded the STEM School Label, while educational institutions are still waiting to be assessed. STEM activities are on the rise, with a growing number of educational institutions involved in the STEM Schools Network, learning outside school, integration of science and arts, STEM curricula, the inclusion of STEM internship projects, the proliferation and growth of collaborations with researchers and universities, and the development of hands-on, experiential activities. It is encouraging to see an increase in the use of information communication technologies, the creation of new media art, the use of virtual reality, 3D, 4D, virtual laboratories, the organisation of STEM days and weeks to encourage exploratory activities in each of the disciplines, the emergence of robotics programmes in schools, and the development of extracurricular STEM activities and clubs.

In the STEM School Mark project, Lithuania is unique in including pre-schools

It is important to note that more projects (international, national) are being implemented in Lithuania to improve STEM activities. Collections of good practices, descriptions and examples of laboratory activities are presented to the educational community. A competence development programme for teachers and STEM centre methodologists, guidelines, etc. are being developed.

The National Academy of Education encourages primary teachers to join the STEM Teachers' Network "Science on the Stage Europe", which provides an opportunity for educators to exchange teaching ideas with an emphasis on the importance of science and technology in schools - to arouse students' curiosity. The platform provides teachers with access to a wide range of courses, resources, methodological tools and international science teacher festivals. Teachers are also encouraged to develop digital learning programmes.

LITHUANIA

Strengths	Weaknesses
- A network of STEAM schools is created - Open STEAM Access Centres are created. - Awareness-raising and educational activities. - Funding for school learning environments, modern, diverse tools, equipment (Millennium Schools Network). - Active cooperation between universities, research centres (VGTU, KTU, VU, LSMU, Life Sciences Centre) is encouraged; - Updating of curriculum content, methods and assessment to promote STEAM and engagement.	- There is no national STEAM strategy; - A united whole-of-government approach to STEM is needed. - Collaboration between educational institutions and businesses is not encouraged.
Opportunities	**Threats**
- Develop a national STEAM strategy. - Increase the attractiveness and relevance of STEM studies and STEM jobs in schools;	- The shortage of STEM-skilled workers poses a serious threat to the success of the European economy;

- Contribute to innovation in STEM education in schools; - Improve and promote existing education-supported industry initiatives; - Strengthen cooperation between industry and education at national level in all Member States; - Collect, organise and analyse material for use by stakeholders; - Create common opportunities for development and progress; - Organise cooperation between educational institutions and businesses; - To secure resources to achieve its objectives and support the activities of its members; - To develop activities to make the STEM sector sustainable; - Strengthen STEM competences; - Increase STEM motivation at all levels of education; - Highlighting the need for STEM, to further develop prosperity, jobs, innovation and social protection; - Address societal challenges through related research and innovation; - Improve the quality of core STEM subjects: mathematics, science, engineering and technology; - To strengthen public awareness and engagement in STEM; - Securing Lithuania's place in global league tables; - Creating, attracting and retaining businesses that can thrive in a global economy.	- The shortage of STEM professionals at all levels weakens Europe's ability to compete globally; - Negative attitudes. - Fear of change. - Lack of motivation of teachers and students; - Lack of digital competence of teachers; - Limited financial resources to meet the need for an educational environment and the necessary innovative tools; - The rapidly increasing dependence of pupils on digital tools, virtual reality and social networks, with their negative effects and loss of time, reduces communication and cooperation.

STEM/STEAM education strategy and education priority

The development of a national STEM/STEAM or science skills development strategy, supported by government, education policy makers and other stakeholders, is recommended. Denmark, Sweden, Finland and the United States - countries that have developed high quality education systems with adequate funding - have a national strategy for STEAM education. The strategy not only sets targets for the appropriate timeframe, but also commits the countries to specific objectives and results through inter-institutional cooperation. When the state proactively initiates the development of STEM education and brings it to the forefront through its own initiative and actions, other stakeholders such as NGOs, industry and business actively join and engage in the cooperation by contributing their human resources, know-how, material means and funding.

Financial investment from public and social partners

Education must be one of the priorities for public financial investment. The higher the priority given to STEAM education at national level, which is reflected not only in the policies implemented but also in budget allocations, the greater the support and involvement of society, i.e. of potential partners, in the various initiatives. It is important to realise that the actions and contributions of the state must be clear and reflect the solution of specific problems related to STEAM education. Stakeholders then see this as a problem of national importance, which in one way or another already conditions (or will in the near future condition) their activities. Seeing STEAM education as a national priority, the country's most prominent and innovative companies are more likely to contribute to STEAM education by collaborating with science centres or initiatives that promote and strengthen science.

Sustainability of initiatives, cooperation and partners' contributions

It is important that STEAM education initiatives invested in by the state and partners are long-term and sustainable. Ongoing STEAM initiatives - where the pattern of activities and their coordination, the contribution and benefits of all partners, clear indicators for activities, and repeated evaluations are specified - are the most successful and long-lasting. While many STEAM education initiatives start with the implementation of national STEM/STEAM education strategies developed by countries, there are good examples that illustrate bottom-up action to reduce the shortage of professionals in STEM fields, improve students' education in these subjects and provide them with real work experience. STEM or STEAM (depending on the country) centres often become the umbrella organisations for such initiatives, bringing together partners, coordinating their activities and bringing them together for discussion.

KAUNAS

Strengths	Weaknesses
- Developing links with universities; research centres and laboratories; o Developing innovative training facilities; - Updating curriculum content, adapting methods and assessment to promote and engage STEM. - Erasmus+ projects; - Participation in various international and republican projects and competitions	- There is no national STEAM strategy; - A unified city-wide approach to STEM is needed. - STEAM is not a priority in Kaunas City Education Annual Objectives.
Opportunities	**Threats**
- To inspire and encourage girls and boys aged 3-19 to learn and engage in maths, science, IT and technology, and to achieve - to further their education in STEM fields not only in Lithuania but also in Kaunas; - Promote awareness among parents of children and young people about the	- The shortage of STEM-skilled workers poses a serious threat to the expansion of the city's economy and hinders its success; - The lack of STEM professionals at all levels weakens the city's ability to compete nationally for growth and development;

importance of STEM subjects and the career opportunities they offer; - Support educational research and lifelong learning and the education of future and current teachers in STEM subjects; - Raise the visibility of STEM subjects in society - through events and the media; - Support research-based STEM - teaching of STEM subjects;	

KAUNAS JONAS BASANAVIČIUS GYMNASIUM

Strengths	Weaknesses
- A STEM team is set up in the gymnasium; - Teacher potential. (About 78% of science teachers are qualified as methodologists). - The Gymnasium offers educational activities. - Classroom research. - Activities: "Future Engineering" (VILNIUS TECH) Integrated lessons on STEM topics; Integrated lessons on STEM topics; Optional practical activity programmes; Educational field trips; - STEM activities; Mobile laboratories arrival; Various activities organised by guest speakers; Continuous professional development for teachers. Collaboration with academic, business and social partners in STEM education Teachers' active interest in innovation. Human resources - most teachers successfully integrate STEAM into their teaching. Integration of project-based activities into the educational process. - Targeted education for gifted students.	- No STEM strategy - Poor STEM infrastructure, access to necessary technologies: - Lack of training facilities. - Continuity of education in the upper grades - Lack of STEAM methodological and teaching materials; - Motivation of students to learn. - Weak individualisation and differentiation of teaching materials. - Lack of competences in working with pupils with SUP. - Poor use of virtual environments in the educational process (epamokes, evadovles, etests, etc.). - No laboratory for science and technology. - Classrooms for science are not equipped with the necessary tools. - There are no classrooms for outdoor pedagogy. - Lack of teacher skills in implementing STEAM. - Insufficient literacy skills among pupils. - Parents' attitude towards STEAM. - Too few teachers use available teaching tools.
Opportunities	**Threats**
- Targeted STEM professional development for teachers: - Finding new social partners/non-traditional teaching spaces. - Organise STEM-themed professional development events/seminars/workshops.	- The absence of a national strategy for STEM education has a negative impact on student achievement. - Fear of change. - Lack of motivation of teachers and students; - Limited financial resources in terms of educational environment and lack of necessary

- Maintain links with universities, research centres (VGTU, KTU, VU, LSMU, Life Sciences Centre); - Expand training facilities; - Adapt curriculum content, methods and assessment to STEM promotion and engagement. - Develop a teacher engagement/collaboration scheme; - Erasmus+ projects in STEM ; - Participate in various international and republican projects and competitions. - Organise social activities for gymnasts. - Renew the educational environment. - Cooperation with STEAM schools to adopt good practices. - Offering non-formal education activities. - Involvement of art and design. - Establish and maintain contacts with new social partners in the Republic of Lithuania and abroad. - Optimal and efficient use of advanced technologies in the educational process in social partner institutions. - Investigate the needs of students. - Supporting motivation in the organisation of STEAM activities.	innovative tools to meet the need for good results. - The rapidly increasing dependence of pupils on digital tools, virtual reality and social networks, with their negative effects and loss of time, reduces communication and cooperation. - The ageing of the Gymnasium's teaching facilities and computer equipment has an impact on the quality of the work. - Lack of parental concern for their child's personal development and scepticism towards STEAM activities - Poor training of specialists. - Distance learning and unforeseen external conditions reduce students' motivation to participate in STEAM activities

Situation in Kaunas Jono Basanavičius Gymnasium

The school's quality assessment revealed that students, teachers and parents primarily associate the school's progress with STEAM activities. The projects implemented test innovative teaching methodologies that integrate the development of subject and general competences.

The Gymnasium actively participates in project activities, which are expected to have a positive impact not only on students' achievements, but also on the school's microclimate. During the educational process, the aim is to encourage students to take an interest in the environment, to explore it, to raise questions and seek answers, to discuss their observations, discoveries and experiences, to discern the causes of natural phenomena, to identify patterns, to learn about the stories of scientific discoveries, and to reveal their relevance to contemporary life.

The newly created spaces provide opportunities for pupils of different abilities to express themselves through the introduction of new educational activities, forms and environments, encouraging natural science curiosity, motivation and experiential, problem-based education.

The STEAM strategy provides a clear direction for action and ensures good results, hence the decision to implement the STEAM strategy as soon as possible. This will include the development of STEAM-related non-formal education, electives, modules and events to stimulate students' interest in science and technology.

The focus will be on developing teachers' competences for STEAM education, disseminating good practices and cooperating with schools that have chosen STEAM.

The overall goal for the successful implementation of STEAM in the Gymnasium:

To foster a school culture conducive to STEAM education.

Goals:

1. To improve student achievement in STEAM, to help students understand the purpose of STE(A)M education.

2. To develop teachers' competences relevant to STEAM education.

3. Promote community education and interest in STEAM topics;

4. Join the international network of STEAM schools and become a STEAM school.

Tasks to achieve the objectives:

1. To improve student achievement in STEAM:

   1.1. modernise the content of education;
   1.2. ensure the creation of a learning environment for STEAM education;
   1.3. join the international network of STEAM schools;
   1.4. promote initiatives in cooperation with academic, social, business partners and non-formal education institutions;
   1.5. offer a wider range of non-formal education programmes, subject modules, electives related to STEAM education.

2. Develop teacher competences relevant to STEAM education:

   2.1. develop teachers' competences in STEAM;
   2.2. make use of various forms of in-service training, international projects;
   2.3. analyse the impact of professional development on student achievement.

3. Promote community education and interest in STEAM topics:

   3.1. develop interactive educational spaces;
   3.2. to inform the school community about current developments in STEAM through various means;
   3.3. promote inter-institutional cooperation by organising cultural and educational events on STEAM topics.
   4. Join the international STEAM network and become a STEAM school:
   4.1. Prepare adequately for joining the STEAM Schools Network.
   4.2. Conduct a STEAM self-assessment/audit;

Recommendations

Collaboration between stakeholders in STEAM education needs to focus on target groups such as pupils, teachers, students, STEM workers and others. The most sustainable partnerships and the collaborations with the greatest added and lasting value are those that take place through specific, defined activities in which each partner is aware of the benefits of participation for the group it represents. When stakeholders carry out specific programmes such as: job shadowing (for students), school visits by professionals (for students), STEM lab sessions (for students and teachers), teacher internships (for teachers), mentoring programmes (for students and students), etc., small groups of partners achieve better results (especially for local level initiatives), and the collaboration remains sustainable and long-lasting.54

One of the challenges for educational organisations is to develop citizens with the potential for innovation and creativity.

Educational innovation is driven by competitiveness among other educational organisations and the desire to be distinctive. The most important barriers that emerge in the application of educational innovation are the lack of support from the community: many ideas that do have the makings of a good solution are rejected because the shortcomings are first noticed, highlighting the lack of competence of the educational community in the application of the various digital resources.

Motivating students requires taking into account as much as possible each child's ability and potential to achieve at the highest level, and discussing ways and methods to involve students through games in setting meaningful goals and objectives for themselves, in planning activities, in evaluating themselves, and in reflecting on their learning. This can be achieved through digital learning tools, gamification of the learning process, digital environments for lesson preparation, questionnaires and visuals; development and change, responding creatively to the changes in the modern world; increased ability to apply ICT in the educational process, systematically developing students' learning, cooperation, practical and problem-solving skills and creativity, information culture and the acquired attitudes to collaborate with the students in the role of their learning advisor, consultant and consultant.

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05

How the teacher can use STEM and Gamification according to their and stu-dents' needs

Part I - Analysis of the needs of students and teachers of STEM disciplines

1. Premise. In the general framework described in the previous chapters, in which it was possible to know the state of health of the school systems of various European countries and the Community policies as regards the transmission and implementation of the study of STEM disciplines, in order to deepen the theme of the benefits offered by the use of Gamification to meet the needs of teachers and students, we believe it is essential to start from an analysis as realistic as possible of what are perceived by both categories as the most urgent needs and requirements for what concerns the learning and teaching of these disciplines.
For this reason, the actors of the educational process were directly questioned through an anonymous questionnaire that probed the major difficulties encountered in learning and teaching STEM subjects and the most pressing needs.
The questionnaire was drawn up with the direct collaboration of STEM teachers. After a necessary and generic personal data section, the questions entered were divided, both for students and teachers, into three thematic macro-areas:

- Training and updating
- Teaching practices and methodologies
- School environment

The answers of about 50 teachers of STEM subjects and of almost 400 secondary school students, aged between 14 and 18-19 and attending a scientific high school and an industrial technical institute, were then examined.
This analysis evidently does not claim to be exhaustive and complete on a strictly statistical level, but it may prove illuminating in an attempt to understand the moods and real perception of students and teachers towards STEM subjects, thanks to the involvement of a sample, albeit relatively small, however authentic of people who for various reasons are directly involved in the educational process of these disciplines.

We present below the questions that were included in the two questionnaires:

Questionnaire on teaching STEM disciplines (for teachers)

I – Training and updating

1. How important is training in teaching STEM disciplines in your opinion?
   VERY
   ENOUGH
   LITTLE BIT

2. What are the aspects you would like to deepen in a refresher course for STEM disciplines?
   RELATIONSHIP (with students and colleagues)
   KNOWLEDGE (disciplinary, pedagogical backgrounds, psychological theories)
   KNOW-HOW (methodologies, use of multimedia tools, evaluation)

3. How much importance do you think laboratory activity has in the training of STEM disciplines?
VERY
ENOUGH
LITTLE BIT

4. How much in your teaching activity do you feel the need to compare yourself with other colleagues who teach STEM disciplines?
VERY
ENOUGH
LITTLE BIT

5. How much would you be willing to increase your knowledge in other STEM subjects?
VERY
ENOUGH
LITTLE BIT

6. How much would you be willing to increase your cultural background in non-STEM subjects?
VERY
ENOUGH
LITTLE BIT

7. How willing would you be to immediately undertake extracurricular professional paths that allow you to acquire an innovative approach to your discipline?
VERY
ENOUGH
LITTLE BIT

II – Teaching practices and methodologies

1. To what extent do you use the following pedagogical approaches in your STEM lessons?

TRADITIONAL FRONTAL LESSON
PROJECT/PROBLEM BASED APPROACH
PEER TEACHING
COOPERATIVE LEARNING
ROLE PLAYING
LAB TEACHING

2. Which evaluation approach do you think is most profitable in the learning process of STEM disciplines?
SUMMARY EVALUATION
FORMATIVE ASSESSMENT
SELF EVALUATION
ASSESSMENT OF THE PROCESS AND PRODUCT THROUGH EVALUATION RUBRICICS

3. What teaching tools do you think are most suitable for a fruitful study of STEM disciplines?

CALCULATORS
SIMULATORS
SPECIFIC SOFTWARE
PAPER MATERIAL

4. What learning resources or materials not available would you like to use?

GRAPHIC CALCULATOR
EXPERIMENTAL LABS
RESOURCES PROVIDED BY INSTITUTIONS OUTSIDE THE SCHOOL OPERATING IN THE SECTOR
RESOURCES FOR STUDENTS WITH SPECIAL EDUCATIONAL NEEDS
OTHER

5. Do you think that the practical and laboratory approach of the STEM disciplines is more training for professional purposes?

VERY
ENOUGH
LITTLE BIT

6. Would you be OK with administering any zeroing courses for subjects such as maths, physics and chemistry prior to the start of the school year?

7. Do you think it is useful to make students reflect on their level of learning also through self-assessment?

8. Do you use content from different disciplines to explain scientific concepts?

9. Do you collaborate with other STEM teachers from different disciplines to teach certain common topics?

10. What do you think are the most important obstacles in teaching your discipline?

- Insufficient or inadequate basic preparation of your students
- Not enough computers or no internet connection or both
- Insufficient number of IWBs
- Lack or insufficient number or inadequacy of laptops, laptops or tablets in the classrooms available to teachers
- Lack of adequate teacher training
- Insufficient pedagogical support for teachers
- Lack or insufficient content in the national language
- Lack of pedagogical models on how to teach STEM in an attractive way
- Organization of school time
- Organization of school environments
- Lack of interest from pupils
- Lack of interest from teachers
- Lack of interest from families
- Poor collaboration between peers from the same disciplines or department or other STEM subjects

11. Do you think there is a national gap in STEM teaching/learning levels?

12. Do you think there is a gender gap in pupils' academic success in STEM subjects?

13. Have you or do you happen to use educational games to convey certain disciplinary contents?

III – School environment

1. Which teaching materials, among those listed below, do you think are most useful for teaching your discipline?

- audio/video materials
- paper materials
- PowerPoint presentations
- Scientific calculators
- Web and computer simulations
- specific software
- Spreadsheets
- Text processors
- Online collaborative tools
- Specific resources for BES or DSA pupils
- Interactive games

2. In your opinion, how much influence does the creation of a positive classroom environment have on the teaching/learning process?

VERY
ENOUGH
LITTLE BIT

3. Do you think your school is equipped for functional teaching of STEM disciplines?

VERY
ENOUGH
LITTLE BIT

4. Do you believe that the socio-cultural context in which you operate is conducive to deepening your understanding of STEM disciplines?

VERY
ENOUGH
LITTLE BIT

STEM learning questionnaire (for students)

I – Training

1. Do you think that the training you received in middle school allowed you to deal profitably with the study of STEM disciplines in high school?

    VERY
    ENOUGH
    LITTLE BIT

2. Did you miss anything in middle school in teaching these disciplines? If yes, what?

3. When solving simple operations or problems, do you generally need external support (calculator, smartphone, software, etc.)?

    VERY
    ENOUGH
    LITTLE BIT

3. When you started high school in which STEM discipline(s) did you encounter the most difficulty?

    Mathematics
    Physics
    Science
    Information technology
    Electrical engineering

4. Which of the listed ones could be the root cause of this difficulty?

    inadequate study method
    shortcomings in basic training
    little time dedicated to the study of these disciplines
    methods of transmission of knowledge by the teacher
    tools available

5. And now, in this phase of your school career, in which of the STEM disciplines do you find the most difficult?

    Mathematics
    Physics
    Science
    Informatica
    Electrical engineering

6. On what do you think the difficulties that you or your peers currently encounter in one or more of a STEM subject depend mostly?

    inadequate study method
    shortcomings in basic training
    little time dedicated to the study of these disciplines
    methods of transmission of knowledge by the teacher
    tools available

7. Do you think STEM disciplines can be fascinating?

    VERY
    ENOUGH

LITTLE BIT
FOR NOTHING

8. Do you think STEM disciplines are more difficult than other disciplines? If yes, which ones?

9. What could be the main motivation(s) that would push you to undertake a university study path based on a STEM discipline?

Passion for discipline
Job prospects

10. What do you think is the greatest difficulty encountered by those who want to continue studying a STEM discipline at university?

II - Teaching practices and methodologies

1. Which tools among those currently used by teachers of STEM disciplines make it easier for you to understand the topics explained in class?

Textbook
Printed materials provided by the teacher
Interactive whiteboard
specific software

2. Are there any tools that you think should be used/used more in the administration of the disciplinary contents of these disciplines?

3. When you attend a lesson on a new topic, which of these elements do you think makes it easier for you to understand the contents?

teacher's explanation
practical exercise supervised by the teacher
teamwork

4. Do you think group work can help individuals overcome the difficulties they encounter?

VERY
ENOUGH
LITTLE BIT

5. How useful do you think it would be to be accompanied by a tutor during the school year?

VERY
ENOUGH
LITTLE BIT

6. What is the main difficulty you encounter in self-study at home?

Difficulty remembering the topic explained by the teacher
Difficulty understanding the textbook
Difficulty in the practical application of theoretical concepts for solving exercises and problems
Lack of motivation in studying these disciplines

7. In your opinion, how could the teaching of these disciplines be improved? You can make one or more proposals also distinguishing between the different subjects:

Mathematics
Physics
Science
Information Technology
Electrical engineering

III – School environment

1. How adequate do you think the equipment available to the teacher compared to your needs in learning STEM disciplines?
VERY
ENOUGH
LITTLE BIT

2. Are there any tools that you think the school should be provided with or should equip students and teachers?

3. In studying STEM disciplines, do you experience a climate of collaboration within the class?
VERY
ENOUGH
LITTLE BIT

4. What do you think is most effective to improve performance in these disciplines, cooperative work or stimulating individual competition?

5. Do you think the socio-cultural context in which you operate is conducive to deepening your understanding of STEM disciplines?
VERY
ENOUGH
LITTLE BIT

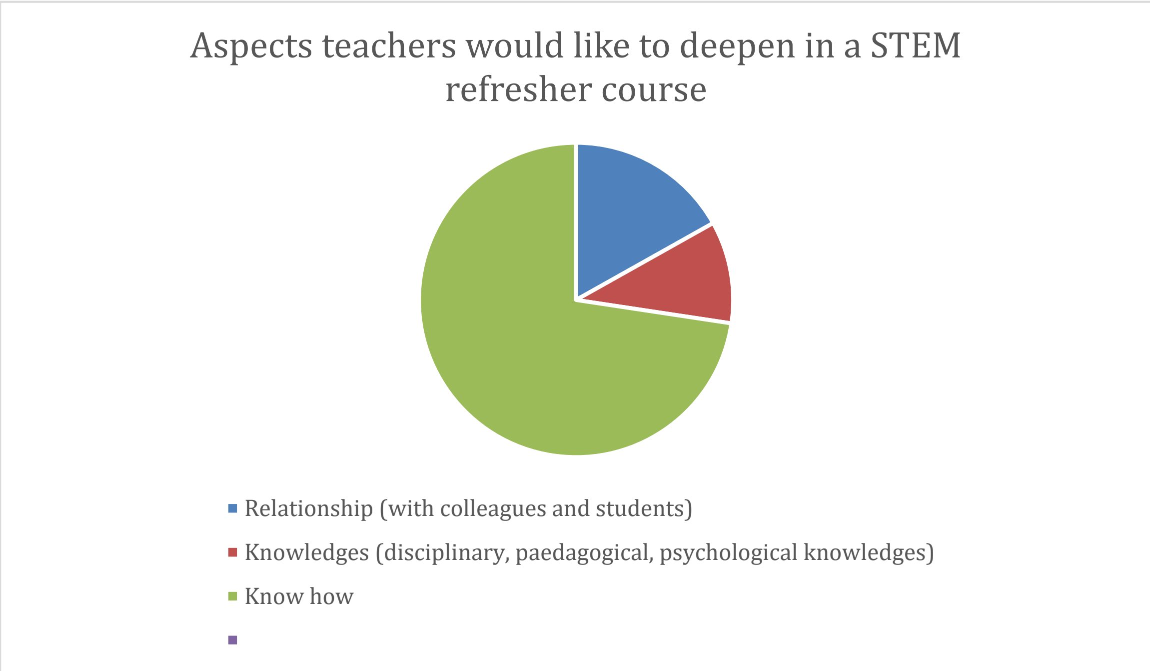
6. Do you think that greater collaboration with external institutions (universities, cultural associations, companies, etc.) could improve the learning of STEM disciplines?

VERY
ENOUGH
LITTLE BIT

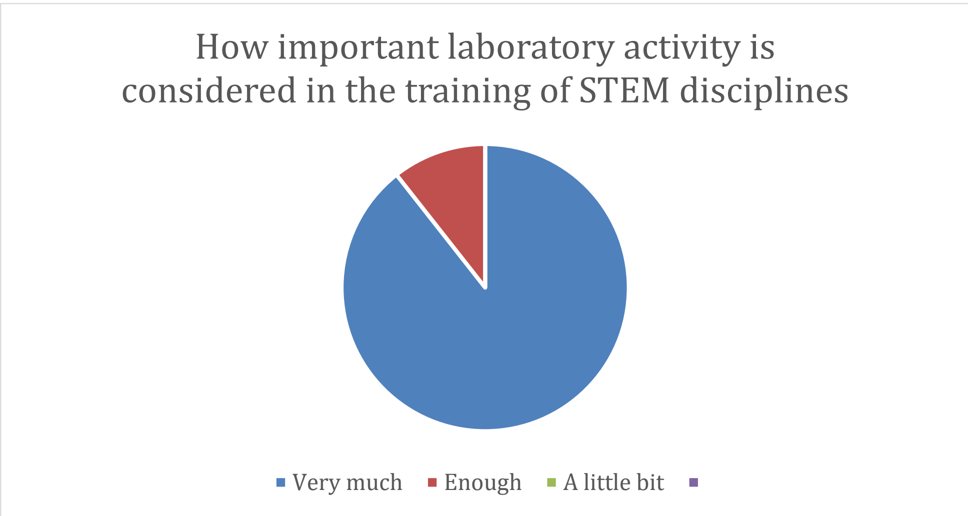
7. In your school career, have you had the opportunity to experiment with the Gamification method for STEM disciplines (use of educational games in order to transmit disciplinary contents)?
Often
On more than one occasion
Rarely
May

2. *Analysis of teacher results*

2.1. Teacher training. The vast majority of teachers are generally aware of the need for specific and punctual training to improve the teaching of their discipline and demonstrate a notable openness towards professional updating and in many cases also the willingness to follow training courses on time extracurricular. The aspect on which the need for adequate training is most felt is that relating to know-how (innovative methodologies, use of multimedia tools and assessment) rather than that concerning the knowledge or methods of approaching students and colleagues (also in form of an in-depth study of issues of a more specifically pedagogical nature).

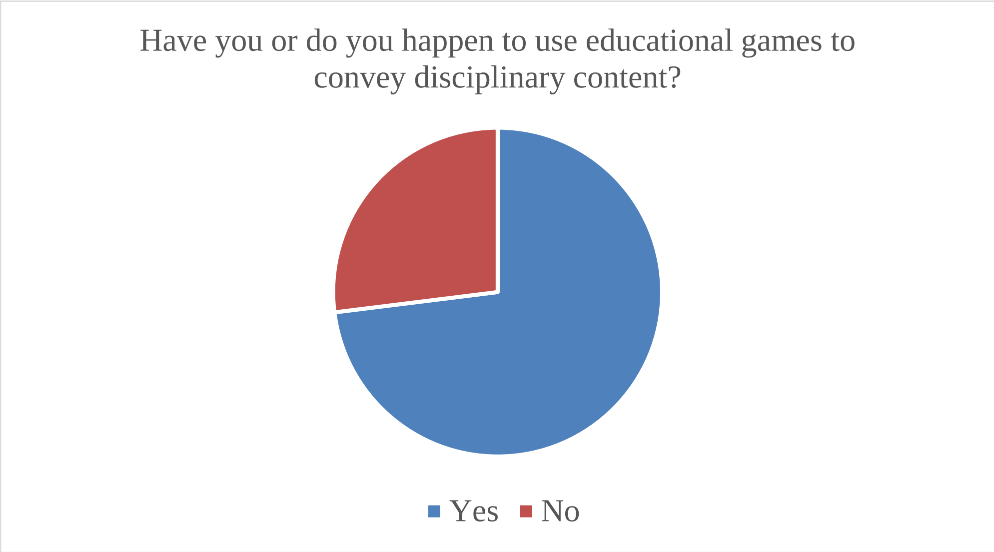


A laboratory-type teaching which therefore exploits new technologies and innovative methodologies is in fact perceived by all the teachers as very or at least quite important for conveying the disciplinary contents of the STEM disciplines.



From a more general point of view, many teachers in this field also said they were willing to increase their cultural background also in STEM disciplines other than the one taught (51% of the interviewees declared in this sense *very* available). Less marked, but still significant, however, is the availability towards non-STEM disciplines (in this case, only 27.7% showed complete openness).

2.2 Teaching methodologies and practices. Based on the answers to the question on the pedagogical approach most used in the lessons (lecture, project/problem-based approach, peer teaching, cooperative learning, role playing, laboratory teaching), the picture that emerges is very varied: quite widespread they are didactic approaches based on problem solving, cooperative learning and peer teaching and in general a laboratory-type teaching, to which considerable importance is also attributed in a professionalizing perspective, but with a still very solid role of the traditional frontal lesson. On the other hand, the methodology of role playing has little luck.
However, the presence for each alternative of a non-negligible, albeit minority, number of people who opted for the "little" answer suggests that for each methodology there are significant resistances and therefore in general a non-uniform didactic approach in teaching the different STEM disciplines.
As regards the use of educational games within ordinary teaching activities, the majority of teachers (72.3%) responded that they happened to use the gamification methodology during their lessons.



Less heterogeneous is the framework relating to assessment methods, where formative assessment is considered the most successful, even if no small importance is attributed to summative assessment and to the students' self-assessment process, which is nonetheless considered a fundamental moment in the process of learning from almost all of the teachers interviewed.
As regards the tools available for teaching activities or which it would be useful to have available, teachers consider simulators and specific software to be proportionally more important than even calculators or paper materials. On the other hand, what is most needed are certainly the experimental teaching laboratories and to a lesser, but still significant, extent, materials and structures made available by external institutions and teaching resources designed specifically for the teaching STEM subjects for students with Special Educational Needs.
Specifically, the materials considered most useful in teaching the discipline are specific software (70.2%), web and computer simulations (53.2%), audio/video materials (46.8%), specific resources for pupils with Special Educational Needs (40.4%).

2.3 Environment. Finally, as regards the so-called environmental conditions in which teachers operate on a daily basis, the greatest obstacle to teaching the discipline is identified in the insufficient or inadequate basic preparation of the students (72.3%), followed by a lack of interest on the part of the same (42.6%), criticalities in the face of which the possible scarcity of available technological tools is much less problematic, in the perception of the teachers.

This indicator is linked to the recorded need, recognized by 83% of the teachers who replied to the questionnaire, to administer zeroing courses in disciplines such as Mathematics, Physics and Chemistry at the beginning of the school year.
The majority of teachers also perceive a gap linked to geographical location at the national level, while the gender gap does not give particular concern, which, based on what emerges from the data at the national level, would seem to become a determining factor above all in the continuation of the path of university studies.

3. Analysis of student results

3.1 Training. The second questionnaire, aimed at students, made it possible to collect almost 400 opinions regarding the study of STEM disciplines and the difficulties students encounter on a daily basis. The answers provided offered an illuminating picture.
Although the majority of students agree that STEM disciplines are or could be fascinating and there is a certain awareness of the skills they provide and their usability within the job market (62.5% of students who responded to the questionnaire would undertake a STEM university course by virtue of the employment prospects offered by the study of these disciplines), there is no doubt that many students find themselves in all or part of their schooling to face difficulties in studying these disciplines which could discourage further study. In most cases it is not a hostility dictated by prejudice: the majority of students who answered the questionnaire do not believe that STEM disciplines are in themselves more difficult than other disciplines (67% against 33%) .
The discipline in which the majority of students encounter the greatest difficulties at the start of upper secondary school is Physics (48.4% of the students interviewed), closely followed by Mathematics (41.8%). This data is not surprising considering that in the Italian education system, physics is a subject that in fact is not studied, if not minimally, during middle school.

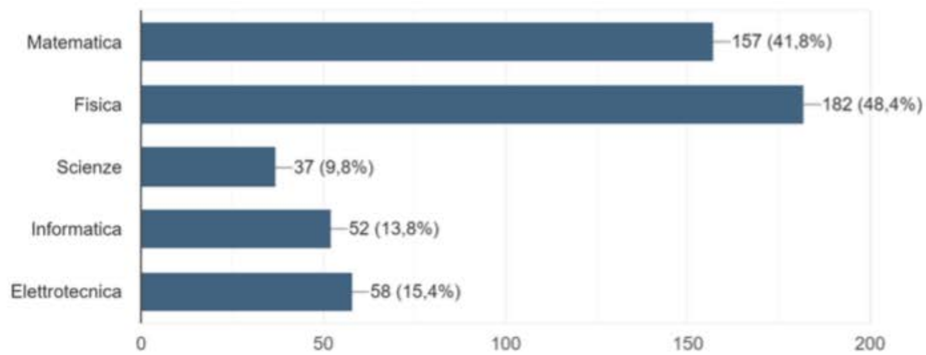
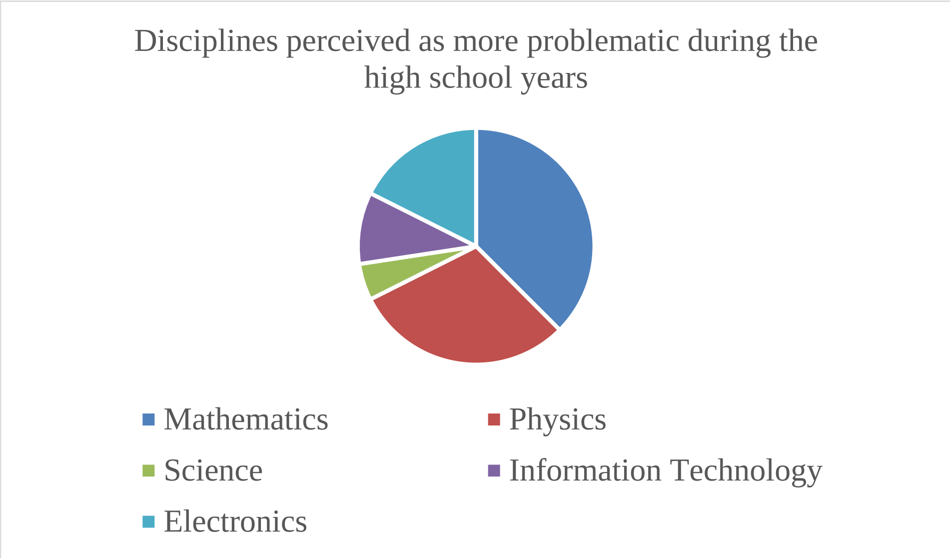


Fig. Disciplines in which the most difficulties are encountered at the beginning of high school

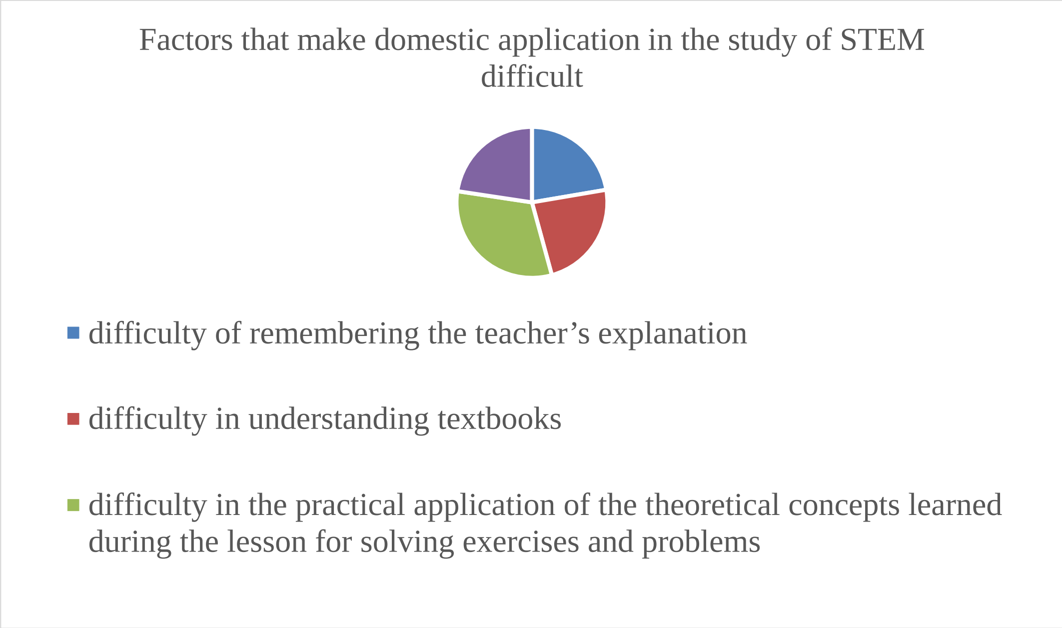
The situation changes over time and mathematics becomes, proportionally, the discipline in which the greatest number of students experience a certain difficulty. Overall, Mathematics and Physics are the disciplines in which the greatest number of students show a certain discomfort in learning.



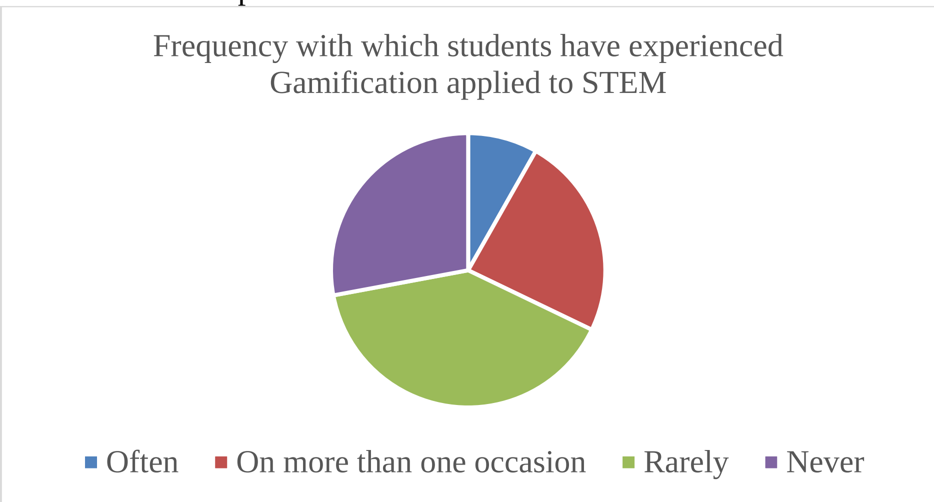
When asked about the possible factors that have determined and continue to determine these difficulties, the majority of students agree in indicating an inadequate study method and deficiencies in basic training. This last indicator should be considered carefully, since in the answers to the previous questions relating to the training received during the previous cycles of education, only a minority indicated the training received during lower secondary schools as insufficient or inadequate, an element that would suggest that the problem rather than a deficient teaching of the disciplines in some phase of the student's career, lies in the absence of an adequate link between the different cycles of education and of an effective sharing between teachers of different cycles on which be the common objectives to be achieved at the end of the compulsory schooling, on the basis of which to calibrate the entire educational path and the respective methods. In the responses, a problematic approach to STEM disciplines is followed by the lack of time dedicated to the study of these disciplines as a determining factor.

3.2 Teaching methodologies and practices. As far as ordinary teaching practice is concerned, most of the students recognize the fundamental role of the teacher in the transmission of disciplinary contents and in the supervision of classroom exercises and consider the digital tools available within the classroom, specifically the Interactive Whiteboard, the most suitable tools to facilitate understanding of the topics explained in class, even more than the textbook or specific software. The situation relating to the difficulties that students encounter in the individual study of STEM disciplines, especially at home, is very interesting and varied.

In the answers provided, against a slight preference given to the difficulty in the practical application of the theoretical concepts learned during the lesson for solving exercises and problems (31.6% of the students), the other answers are substantially divided balanced between the difficulty of remembering the teacher's explanation (22.3%), the difficulty in understanding textbooks (23.4%) and the lack of motivation in studying these disciplines (22.6%).



Therefore, it does not appear to be a coincidence that when asked how to improve the teaching of STEM disciplines, despite the variety of proposals registered, a constant is represented by the request by students to implement practical and laboratory activities and game-based teaching.
And in fact, when asked about the frequency with which students experience the method of Gamification and Educational Games applied to these disciplines during their educational journey, a clear majority of students provided the answers Never or Rarely, as proof of the fact that Gamification and the introduction of Serious games within ordinary teaching is a path to be pursued with more intensity and regularity, above all considering the critical issues previously highlighted in the students' approach to these disciplines.



3.3 Environment. Finally, as regards the environmental context, the students do not seem particularly dissatisfied with the tools available to teachers and agree on the fact that teaching based on cooperation should be encouraged within the classroom rather than a model of teaching that stimulates competition.
More generally, as far as the local context is concerned, even where the external environment in which the school is inserted is favorable and fertile for the study of the disciplines, greater osmosis and collaboration with institutions external to the school (universities, companies, cultural associations) is perceived as an urgent need by almost all the students.

Part II – Reflections and suggestions on the use of STEM and Games to meet the needs of teachers and teachers

II. 1 The scientific knowledge possessed by the school population, according to what emerges from the most recent statistical analyses, is constantly worsening even though we are in an era of great technological innovation. Periodic surveys conducted by national agencies and education bodies also confirm that students in some EU countries lag significantly behind their peers of other countries in achieving the levels of knowledge and skills essential for full participation in economic and social life. Furthermore, there is a gap in results even within individual nation states, with significant differences between the various regions and between urbanized and rural areas.
The results of the questionnaires presented above confirm, starting from the particular empirical data, this picture and are emblematic of a phenomenon that is assuming increasingly worrying proportions with the progressive weakening of the basic education of students.
On the other hand, what has been found more clearly within some EU countries could very well, albeit with the necessary distinctions, also concern many other European countries, where there is however a serious difficulty in transmitting knowledge relating to some STEM disciplines, especially with regard to some of them, such as mathematics.
More generally, some indicators state that:

- despite the increased availability of access to digital information, students do not demonstrate the adequate ability to select them in a critical way, also for the purpose of building their own citizenship;

- despite the need for subjects who are going to occupy roles and spaces of the technological contemporaneity, the number of enrollments in scientific faculties is not adequate to what is the demand for workers specialized in STEM disciplines.

Therefore, it is increasingly necessary to use a teaching methodology that involves a mix of the use of new technologies and laboratory teaching as a fundamental vehicle for making students passionate about STEM subjects, educating them in reasoning and in the scientific method, with the final aim of training citizens who may be able to adopt creative and scientific thinking and make an important contribution in terms of innovation and knowledge creation, acquiring knowledge and skills to develop cognitive processes and thus contribute to the development of the society in which they live.
It would also be appropriate to carry out a revision of teaching methodologies aimed at integrating scientific disciplines with non-scientific ones in view of the ever-increasing complexity of reality: the problems that humanity is facing today can hardly be solved with the application of single knowledge.
Therefore, in order for teachers to meet the educational needs of students as much as possible, and to break down a certain rebelliousness in making them range across the various fields of knowledge, an approach to teaching that tends to integrate the various disciplines in a more or less deep and systematic way would be desirable.
More generally, the transdisciplinary approach to teaching creates an open space where students stop categorizing what they have learned into single “subjects” but instead use all the knowledge they have assimilated and the skills they are able to apply to solve problems in the most varied fields (development of skills).
Such integration between the various disciplines requires active learning methods, such as:

- The **tinkering**, an informal learning in which one "learns by doing" (the aim is to express oneself and experiment, creating objects with poor materials, focusing more on the process than on the result; this methodology represents a constructionist approach to the teaching of scientific disciplines);

- **creative learning**: the Lifelong Kindergarten which stands on four pillars (projects, passion, peers, play);

- **TEAL** (Technology Enhanced Active Learning, the "technologies for active learning"), a teaching methodology that combines the classic frontal lesson with practical computer simulations, all of this within a suitably configured laboratory.

A teaching oriented towards these objectives and inspired by these principles will have to be based on the validation of teaching models that consider efficient and effective learning environments that support experimental investigation and planning with the information and cognitive aspect. The result will be an inclusive type of context that will be able to make even the weakest students more involved in training activities, for whom late actions (remedial courses) prove to be ineffective as well as economically relevant.

II.2 The pedagogical approach based on educational games is in this sense particularly suitable for scientific subjects. It is based on the high pedagogical contribution that is inherent in the game. In fact, the game stimulates collaboration and healthy competition between students, it helps to get to know themselves better, to challenge themselves, to look for their own limits and then to overcome them. The game encourages self-improvement for personal growth or to contribute, with one’s abilities, to the success of the team, or, conversely, encourages to rely on teammates in case of difficulty, i.e. to live in community with harmony. The game stimulates creativity, imagination and ingenuity.
Experiences of this type carried out in educational activities for the teaching of scientific disciplines show that the students want to win because they put themselves to the test, but accept defeat and make it an opportunity to improve, do not end up in controversy and respect their classmates and arbitration decisions even when they do not agree with them. They consider the rules essential to the success of the game, sometimes using them with cunning and imagination to gain an advantage over the opponent, while moving within the limits established by the rules themselves.
And the teachers? According to some surveys, they do not always seem sufficiently motivated to update their professional training to grasp and implement the innovations proposed in the field of didactic innovation. There is little aptitude for taking into consideration the experience gained by other colleagues and in some cases, despite the existence of collegiate bodies, the comparison of experiences is lacking. Therefore, there is an increasing need for a cooperative teaching community, motivated and aware of its social role and for permanent training of teachers to reduce skepticism and resistance regarding the introduction of new teaching systems. In daily practice, despite the considerable efforts made for activities such as programming and verification, teaching is rarely supported.
Scientific and STEM disciplines cannot do without laboratory teaching, an opportunity to do/observe and reflect on what is done/observed, activities that play an important role in learning processes and in strengthening scientific skills.
The operating methods must be carefully designed by the teachers taking into account the reference context and the contribution provided in the field of science teaching.
The laboratory does not necessarily designate a more or less equipped physical space as much as an area for reflection on the most suitable and functional methodologies for learning scientific content. In this context, the pupils are led to ask themselves questions and, with the help of the teacher, formulate answers through field experiments.

From this point of view, technological equipment is naturally necessary, but alongside these the ability of teachers to use them in learning processes must be implemented. The mere introduction of technological means is not enough to immediately raise the levels of education. Indeed, the presence of these resources raises the quality of the school system as a whole, but does not always contribute quickly to improving the results achieved by students.
The technological revolution that has taken place in recent decades has primarily affected the school which had and has to necessarily follow its evolutions and changes in order to adapt to the changed context in which it operates and avoid entering into crisis.
The introduction of new technologies into the school system has, in fact, given way to a process of significant transformations in the way of interacting, knowing and communicating and, consequently, in teaching practice, both in terms of content and on a pedagogical level. The dissemination and use of these tools in the school environment has become necessary and inevitable because only through their use it is possible to arouse in students a sense of belonging to a more familiar world, greater curiosity and enthusiasm, from which an increase in the will to take action and get involved derives.
By themselves, however, and if used inappropriately, digital tools may not be enough; the risk is precisely that of using them without, however, exploiting them effectively, thus limiting their potential and the advantages that could arise from their use.
Therefore, the teacher’s role must be to research and reflect on the best teaching practices and methodologies which, by transforming the classic scenario of the lesson, guarantee an educational offer capable of making all students achieve educational success.
It goes without saying that this new technological world inevitably imposes a change in the *modys operandi* within the classroom context, and it is precisely thanks to careful and profound reflections that, in recent years, a new learning methodology has gradually been developed and disseminated: Gamification, which, entering the context of smart education, uses the typical dynamics of the game/video game (rankings, points, rewards, levels to pass) in order to achieve greater motivation and a more intense, if not integral, involvement of students in their learning process.
Since 2010 the gamification has become, as well as a word in common use, a fully accepted teaching methodology in classrooms around the world. It consists in use of game design elements in non-playful contexts, such as education, marketing, health, corporate training, politics. At school, "Gamification" does not mean "making the lesson playful", rather it is applying elements of video games in teaching, to stimulate the learning of traditional subjects.
According to some game designers, video games are able to bring out the best in us, allowing us to focus on our goals without distractions. In fact, video games are able to stimulate motivation, interest, creativity, a sense of belonging and happiness, feelings that translate into resources that can be immediately spent in daily activities.
However, gamification does not necessarily require the use of video games. It is possible to "gamify" the activities by simulating, in an analogical way, the mechanics and plots typical of game design.
Evidence shows that Grade-motivated learning is only effective in the short term, on the other hand, the willingness to learn broader skills ensures that they are maintained in the long term.
The strategies of gamification guarantee the subject ample space for freedom, customization, choice, and returns progress is immediately visible**.** The error is no longer a daunting, anxiety-provoking definition, but it is an impulse to try again. Instead of the traditional assessment, typical video game scoring-evaluation systems could be inserted, such as rewards ranging from zero onwards, instead of the classic subtractive evaluation, calculated on the basis of errors.
Learning is a continuous process of confirmations and adjustments: it is always based on the comparison between the expected output and the one actually obtained and it is only through immediately visible feedback that the shot can be adjusted.
Other key elements of gamification are the mystery, the action, the risk, the uncertainty about what could happen and an emotional plot also very useful for increasing social skills. All these elements contribute to facilitating immersion and fun, greatly motivating students.

Finally, gamification has the advantage of translating school requests into concrete possibilities within the video game, into skills useful for the purpose of the learning challenge. It is very important to contextualize a school subject and transform the abstractness of a task into a concrete test, the purpose of which has a practical, immediately understandable and usable sense.

Which platforms are useful for the introduction of gamification in the educational field? Currently, there are a multitude of them and with different characteristics:

- test creation platforms (e.g.: Kahoot!, Panquiz, Quizizz, Socrative, Plickers),
- softwares that help process digital content (e.g.: Wordwall, LearningApps, Flippity, Educaplay and TinyTap),
- platforms for building Escape Rooms (e.g.: Genially and Metaverse).

Among these let's consider Kahoot! as an example: a learning platform that helps make learning mathematics, but also other disciplines, more fun, therefore, more effective and which, at the same time, allows you to integrate traditional teaching with the digital through the creation of quizzes to be used both face-to-face and remotely.
The quizzes can be customized in different ways, depending on whether the free or paid version is used, following a simple registration on the website by the teacher; however, students are not required to register or download the app in order to take the quiz created by their teacher, but just use the pin code or referral link to gain access.
This tool helps to increase students' motivation by offering them the opportunity to test their knowledge and to motivate them to keep learning; while the students explore their knowledge related to certain topics, the teacher will be able to see, through the statistics section, a report specifying:

- the final classification with the relative position occupied by each student,
- the correct answers as a percentage (section which contains the answers given by each student, the incorrect ones, the response time taken and the score acquired for each question),
- the unanswered questions,

- the final score.

A possible application of this quiz can be, for example, at the end of a lesson to verify understanding of the topic covered or, in any case, on any other occasion within the teaching activity in which it is deemed appropriate to include it.
Obviously, the teacher will have to prepare his quizzes in advance, choosing the type and number of questions, which he can modify at any time by saving them in his own private archive; however, this does not exclude the possibility of sharing them with other users, or, if desired, of making them public.
Kahoot!, therefore, proves to be an excellent tool for introducing new topics, for learning new concepts, for carrying out exercises before tests, for creating challenges with other classes, or, much more simply, for creating a fun activity in the classroom, which helps break up the routine and give a touch of lightness to subjects that have always been more difficult for students, such as mathematics.

II.3 How can the use of gamification improve the learning process of mathematics, physics and other STEM disciplines?
The potential of gamification techniques is, in fact, nowadays quite well known; in reality, thanks to the inclusion of didactic contents in a playful context, it is possible to make the study environment more friendly and, consequently, to give a more sympathetic character to the mathematical content, inevitably making it more effective also the related learning process.
Furthermore, building a game-based educational environment gives a way to dissolve negative feelings, such as the fear of making mistakes, of not remembering and, above all, of not being able; fears that, usually, many students perceive towards mathematics. This factor should absolutely not be underestimated, since it has been known, practically always, that the perception and attitude we assume towards a task that is assigned to us, influences the way we proceed and relate to it and, therefore, the final result. The more positive our students feel about discipline, the more motivated and stimulated they will feel to learn.
Another factor to take into consideration is the way in which most of the students generally perceive some STEM disciplines, for example mathematics, i.e. sterile, far from reality, and its language, i.e. cold, detached, poorly understood; creating games in which there are constant links between purely theoretical aspects and concrete fields of application would certainly help to bridge the gap between mathematics and reality by ensuring that students begin to perceive as real, useful and applicable, the mathematical concepts used in the playful context.
Furthermore, with regard to students, attempting an approach of this type with mathematics would help to:

- arouse attitudes of curiosity and reflection, which would lead to a greater awareness in the learning process;
- start a process of maturation from a cognitive point of view,
- improve concentration,
- develop imagination, creativity and imagination
- develop empathy and other affective-relational skills,
- learn by doing,
- develop logical-mathematical skills and competences.

But what role is played by teachers in all of this? In reality, if we pause for a moment to think, this revolution concerns them personally, because they are the ones who have to work and change the mechanism relating to the teaching-learning process that has existed up to now.
Using gamification can undoubtedly have advantages and disadvantages for teachers. In fact, the teacher will have to "spend some time" in planning these activities and, above all, make sure that they are not trivial and ends in themselves; this implies that it must, first of all, establish an objective, so that during the activity, and above all at the end, it is actually possible to establish whether this has been achieved or not. Furthermore, starting from the analysis of the students belonging to the class context, it will have to identify, appropriately, the resources, both technological and pedagogical, to be used in carrying out the activity itself.
Making the learning environment immersive, motivating and constructive for the students, however, implies that it is at the same time for the teachers, who, seeing their students investing in the learning process, feel, in turn, motivated, satisfied with the work done and the results achieved, thus ending up loving their job more and more.
Also with regard to another discipline, Physics, new technologies can be successfully applied to allow the learning process to be more dynamic, interactive and closer to the students' reality.
For example, the use of a PC with which to observe interactive simulations not only facilitates, but indeed can attract students to the study of scientific disciplines, generally considered difficult to understand.
Physics is generally seen by high school students as a discipline full of apparently meaningless formulas, to be memorized and applied.
Instead, in order to obtain greater awareness and an appropriate and coherent use of the scholastic notions of Physics, we could try to combine the traditional teaching part with a "game-based" teaching part, making the lesson more interactive and attractive for the student.
In the century in which we live, interactivity and being constantly connected predominates; the use of new methods is essential to make the student active in the learning process.
Therefore, precisely because we live in a connected world in which students are increasingly inserted into and bombarded with information of various types, it is up to the teacher to act as a mediator between technology and learning, stimulating the interpretation and contextualisation of information and encouraging a cooperative construction of knowledge.
It is certainly correct to state that the Internet can help in the educational process and that schools must explore its different potentials.
We have various communication and information mechanisms available, such as chats, blogs, social networks, e-mails of daily use, but, among the most recent learning methodologies, gamification is one of the most important: taking advantage of the interactivity provided by modern means and obviously from the principles underlying the very concept of entertainment, gamification represents an extremely effective tool capable of conveying messages of various types.
In the school environment, through gamification it can generally be simple to be able to involve students, creating motivation and greater attention in the activities to be carried out.
We all observe them on a daily basis and we know how and how close the link is between them and (video)games.
An example that would introduce gamification in the school context would be the use of smartphones in the classroom. Clearly the teacher must know how to use the smartphone as a pedagogical tool for teaching and at the same time it is necessary that he becomes familiar with the tool itself so that he can have full command of the "game based" lesson that he wants to carry out.
Gamification can therefore offer a closer connection between school and student, introducing the didactic component into their world made up of smartphones, digital interactions, interactive games. In other words, it uses the playful element for a non-playful but didactic purpose.
Specifically: how can gamification bring benefits to the teaching of Physics?

Before moving on to the properly playful part, it is first of all important to make the student understand that Physics is an interesting subject. In doing so, the teacher must convince the student that, despite the difficulty he will inevitably encounter, it is not a boring subject. As proof of this, it is enough to show some examples of the connection between his theoretical concepts and the most common situations of daily life.
There are more ways to explore physics than just the usual school setting.
Games such as puzzles, guessing games, and other fun activities can be added over the course of the study. Hence, educational platforms can become real educational tools. For example, Kahoot transforms classroom teaching into a game that stimulates learning and competitiveness among students, having the teacher able to create a series of questions sorted by level of difficulty and with an appropriate response time.
Or playful applications for smartphones, such as the very famous game "Angry Birds", which can become a useful tool for understanding through experience and trial and error the meaning of classic physical concepts encountered in the world of mechanics, such as the parabolic motion of a projectile, the center of gravity of a rigid body, the static and dynamic friction between a body and a surface.
This is how the natural motivational spirit and (positive) competitiveness between students, or groups of them, typical of the playful environment, can significantly promote learning.
If a certain physics topic is treated through a "game based" lesson, it will be much more likely that the same will be actively absorbed by the students.
In this sense, Gamification is able to produce in the student that mental snap for which a formula written on a sheet of paper "comes to life" and is able to explain the reason for a physical phenomenon or explain the reason why the variation of some parameters within a formula can cause different outcomes of the same phenomenon:

- Why do we see an ideal gas expanding in this animation?
- Why in this video a ball stops after *n* meters, having descended from the top of an inclined plane?
- What happens in this interactive simulation if we change the value of the initial speed of a projectile fired into the air?

It is therefore clear from these possible questions how the use of gamification can make the various concepts of physics visualized and appreciated directly from the classroom.
If you wanted to create a possible application of gamification to Physics with a class, you could think of designing an app that includes, for example, the following game: a ball starts from an initial point A and must arrive at an end point B, walking along a path made up of inclined planes (ups and downs), vertical falls, collisions with springs and other bodies…
The objective would be to make the player guess/calculate, after having clearly studied the main laws and relationships of Mechanics, the correct value to be assigned to the various parameters involved (mass of the ball, inclination of the plane, elastic constant of the spring, coefficient of friction of the ground, height of the fall…) so that the ball lands.
Even mistakes will teach!
Any incorrectly assigned values will lead to different outcomes of the phenomenon and will in any case represent a useful learning experience: learning by doing and learning from mistakes.
However, using gamification, it must be reiterated, does not mean making the lesson fun or wasting time with games, but stimulating learning through new study methods. When applying gamification at school, three main basic concepts of the game must be kept in mind:

- Establish levels and assign scores
- Give feedback and track progress
- Reward based on the difficulty of the goal achieved

Another very important point of gamification is to keep the attention level of the students high, increasing participation in the lesson: the students become the protagonists of the lesson and directly learn concepts that in a classic frontal lesson would be particularly complex. This allows faster and more effective (long-term) memorization of the concepts covered and the student, having the possibility of directly monitoring his progress, manages to be increasingly motivated to move forward on his path.
In nowadays teaching, a real turning point undoubtedly occurs when the design and creation of a video game comes about through the application of computational thinking. The latter helps to develop logical skills and the ability to solve problems creatively and efficiently.
In computer science, gamification is used to improve the student experience in applications, websites and online platforms.
The advantages of gamification in teaching and learning information technology are many: first of all, it increases the so-called student engagement, i.e. their involvement and their attention towards the subject; moreover, it can improve learning and information retention, thanks to the use of game-based learning techniques.
Gamification is often used in computer science teaching to make learning more engaging, fun, and motivating for students. Some examples of how gamification is used in computer science include:

1. Educational games: there are a great number of educational games that help students learn programming, web design, and other computer skills, such as Scratch, a free, student-friendly coding environment, which with the help of the cute kitten mascot of the program introduces students to the world of programming with a motto: "imagine, program, share".

2. Leaderboards and Badges: educators can use leaderboard and badge systems to encourage students to learn and improve their computer skills. For example, students can receive a badge for completing a project or solving a particularly difficult programming problem.

3. Competitions: programming competitions are a popular way to encourage students to improve their computer skills.

4. Simulations: Simulations can help students better understand complex computer science concepts. For example, a network simulation can show how data transfer between computers works.

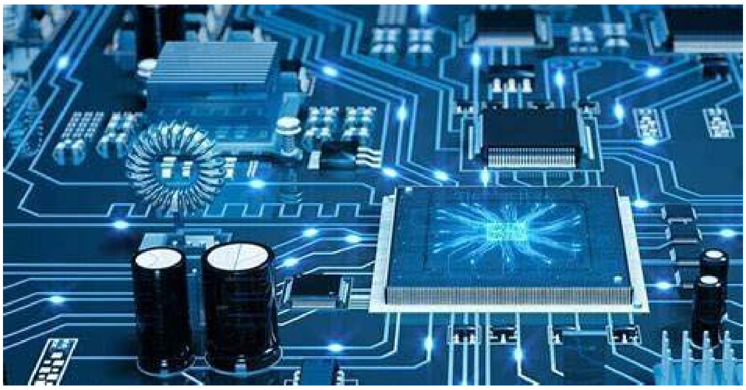
A practical example of using gamification in computer science could be the creation of an educational game that teaches young people to program. For example, you could develop a game in which players take on the role of programmers who must complete a series of missions by writing code. The game may present a variety of challenges that are based on the basic concepts of programming, such as boolean logic, loops, variables, control flow statements, etc. Players would earn points and level up as they successfully complete missions.
In this way, the game becomes a fun and engaging experience that encourages young people to learn to code. Additionally, healthy competition between players could increase motivation to learn and perfect their coding skills.
The use of gamification in computer science can also be extended to other areas such as cyber security, data management, artificial intelligence, machine learning and many others, making learning about these subjects more engaging and interesting.
The use of the Kahoot platform can also be recommended for teaching computer science to propose interactive quizzes that students can participate in using their mobile devices within, for example, a programming lesson.

A practical use of Kahoot in computer science could be to create a team quiz where students work together to answer questions about the programming language they are studying. Questions might cover topics like syntax, variables, control flow statements, and so on.
To get started, the teacher can create the Kahoot quiz and divide the class into teams. Each team chooses a name and a color. During the lesson, the quiz is projected onto a screen and students can join the quiz using their mobile devices. The quiz consists of a series of questions that students must answer as quickly as possible. Each correct answer earns points for the team.
Using team Kahoot in computer science has many advantages. First, it encourages the active participation of all students, encouraging them to work together and collaborate. In addition, the game stimulates healthy competition between teams, increasing students' motivation to learn the programming language. Finally, the quiz is a great tool for assessing students' understanding of the topics covered in class.
As for other teachings related to the world of STEM, such as the teaching of Electrical Engineering and Electronics, it must be said that it integrates scientific and technological skills in the field of materials and in that of design, construction and testing, in the production contexts of interest, in relation to electrical and electronic systems, electrical systems and automation systems.
In particular, the design, construction and management of civil and industrial electrical systems and installations are explored in the "Electrotechnics" section.
This discipline must contribute to the achievement of the following learning outcomes, expressed in terms of skills:

- in **application**, in the study and design of electrical and electronic systems and equipment, **of electrical engineering and electronics processes**;
- in **use of laboratory equipment** and sector and application of measurement methods to carry out checks, controls and tests;
- in **analysis of the types and technical characteristics of electrical machines and electronic equipment**, with reference to the selection criteria for their use and for their interfacing;
- in **of individual and group activities** relating to professional situations and drafting of technical reports;
- in **analysis of the value, limits and risks of the various technical solutions for social and cultural life**, with particular attention to safety in the places of life and work, to the protection of the person, the environment and the territory.

Very often in the teaching of Electrotechnics and Electronics, teachers encounter many difficulties as the catchment area is often devoid of basic knowledge and skills such as those of mathematics and physics, essential for learning the fundamental laws of Electrotechnics and Electronics.
Another criticality of great importance is that of putting into practice laws and principles that seem completely abstract and which instead concern real and common phenomena such as those of the current, of circuits, of the transmission and reception of signals, of the materials involved, of electric machines, electronic devices and the design of electrical systems in general.
This is also in light of the fact that these disciplines are the basis for the creation of modern devices that currently dominate the world of technology and in particular the digital world, essential topics for both students and teachers, especially in relation to the new national provisions in theme of innovative learning with related methodologies and teaching strategies suitable for the pursuit of the purpose.
In this sense, gamification could play a respectable role in the teaching of Electrical Engineering and Electronics, precisely because through the key elements of this very interesting didactic approach it would facilitate and motivate students to learn electrical and electronic phenomena, contextualizing

the discipline through the transformation of a purely scholastic task into a concrete test and with real and tangible developments, pertaining to the daily life of every family (home automation, Internet connection devices, smartphones, voice assistants, IoT, etc…).



A possible application of gamification to the Electrotechnical and Electronics discipline could be an app that provides a sort of "escape room" from which the participant must exit by passing a series of tests associated with the resolution of queries, questions, exercises about the fundamental laws of the discipline.

06

How the teacher can motivate and inspire students using STEM and Gamification

The demands of contemporary education directed at developing competencies are not achievable in a type of education that overemphasizes the process of teaching and does not appreciate learning. Contemporary pedagogic trends change this paradigm by changing the focus from direct teaching towards the concept of active learning, the type of learning in which a high degree of independence and self-regulation is achieved. The crucial element being the application of specific thought strategies and cognitive skills that enable spotting important information, their connection with the existing knowledge, as well as the necessary critical judgment on the topic while also enabling long term memory. Strategies, methods, and pedagogic approaches of active learning, such as flipped classroom, project learning, collaborative learning, and gamification, support the creation of learning experiences that enable the development of students' knowledge. Each approach has its own place in the teaching process, and we use them in accordance with the educational goals we want to achieve.

Recent studies have shown that by introducing games into the teaching process, better results can be achieved in the students' learning process.[1] The focus the research was on the application of games in teaching, and the results have shown that in this way students achieve better results compared to the usual frontal type of teaching. In addition to this advantage, there are side effects that are also realized: temporary motivation and excitement, demotivation due to bad results, reduction of concentration and the like.

A research conducted by a different group of authors[2] indicates that the main advantage that occurs when implementing gamification in the teaching process is the increase in student motivation. The game is considered an intuitive way of learning for children from an early age, and for this reason learners easily accept it as a novelty in the learning process.

The introduction of games into classes can be implemented in various ways, depending on which way suits students best. Game-based learning is one of the simplest ways to implement a game in the teaching process. It is defined as the introduction of play into learning in such a way that play is used to master more difficult or uninteresting units. An example is the use of quizzes to check the mastery of the taught content. The quiz enables simple knowledge checking, all students are encouraged to participate and the routine of the frontal type of teaching is changed in such a way that the student gets a more active role. In this way, an element of fun is introduced into the learning process to increase motivation and stimulate student activity

The game is already used in teaching, but not every use of the game in teaching is gamification. Gamification is defined as the use of game elements in a non-game context with the aim of increasing interest and motivation. It was created as a result of the phenomenon of computer games, and it represents the application of mechanics and dynamics taken from computer games, which serves to solve problems and achieve certain goals. This means that parts of the game are used in certain situations in which the game has not been applied so far. It can be concluded that in gamification, by applying parts taken from games, students are stimulated in order to achieve the desired behavior and results. As previously mentioned, the game primarily affects motivation.

[1] Alsawaier (2018), Nikčević-Milković , Rukavina and Galić (2010) and Rider (2017)

[2] Al -Azawi , Al -Faliti , and Al - Blushi (2016), Garris, Ahlers , and Driskell (2002) and Herbert (2018)

Once the concept of gamification has been defined, for its understanding it is necessary to clarify the mechanisms and dynamics that make up its integral part. The mechanisms represent activities taken from games that are used to achieve desired results (points, gifts, powers, levels, etc.). The dynamics represent the processes that take place to perfect and achieve certain skills by means of which progress is made in the game. Repeating the dynamics can mean determining the content or re-crossing a level that was not successfully passed in terms of progress. Teachers can choose various mechanisms by which they can adapt lessons to students by applying gamification. Teachers should use mechanisms in the gamification of teaching depending on what they really need and avoid using all the mentioned mechanisms to gamify teaching. In the case of using too many mechanisms, there is an overload of the student's attention, which can lead to a drop in concentration and misunderstanding of the actual task presented to the student.

Based on research, Rider (2017) states that during the use of gamification in classes, there were better results in terms of grades, but a unanimous conclusion cannot be made that this is solely due to the application of gamification. Such results may occur due to the use of different materials, changes in working conditions, different timing of classes or other things. What can be concluded is that gamification affects the improvement of student motivation. It is recommended that gamification be used in classes as early as possible, i.e. at the beginning of the school year, so that students are involved from the beginning and motivated for further work throughout the school year.

Based on further research, it was concluded that students become more motivated and encouraged to participate if they are given the freedom to make decisions and the opportunity to participate in the creation of the game. During the research, the students initially participated in a gamified lesson created by the teacher and disinterest appeared after a week. Students were offered the option to opt out of gamification. For these purposes, a survey was created where students chose whether they wanted to continue participating in lessons with gamification. Only one student stated that he was satisfied with the gamification and wanted to continue participating, while all the others chose the option to create a new version of the gamification. The students were offered the opportunity to independently create a way of working and possible tasks that were eventually controlled by the teacher. In this way, students are encouraged to develop motivation, which was initially lost due to the application of gamification.

At Secondary School Ban Josip Jelačić in Zaprešić (Croatia), we conducted a research on gamification in the classroom, in which both students and teachers participated. We interviewed one hundred students and fifteen teachers. The opinions of the interviewed teachers and students were mostly positive about the application of gamification. All the students who participated in the research find gamification interesting, they recommend that teachers make greater use of gamification in class, that is, to start using it if they are not using it. Most teachers stated that gamification has a positive effect on stimulating students' motivation and increases their interest in participating in classes. The most common positive comment from the interviewed students was that the use of gamification presents the teaching content in an interesting way, which encourages students to learn actively. It can be concluded that teachers and students believe that gamification has a positive effect on student motivation and does not distract concentration when it is applied in class. The statements of students and teachers about motivation confirmed the results of the research by Nicholson (2013) and Rider (2017), who state that gamification can influence the increase of students' motivation and interest to participate in classes.

During the interviews, several interviewed teachers pointed out that they used gamification to a large extent when teaching students with developmental disabilities. They think that using gamification makes teaching easier for students and brings the content closer by using appropriate games. This topic is included in the research conducted by Whalen et al. (2010), which shows that gamification has a positive effect on the development of communication skills of students with autism and attention deficit hyperactivity disorder.

Some teachers also mentioned the disadvantages of introducing gamification into classes: diverting attention from the teaching content to game elements and the possibility of creating dependence on technology.

Gamification in teaching - when, how and why?

Research has confirmed the positive influence of gamification on student motivation in the learning process, however, it is necessary to see how and when to use game elements and for what educational goals.

At the beginning of the class, the appropriate gamification is the one which will allow brainstorming in some way and recalling some prior knowledge as well as awakening interest in the topic that will be discussed. This can be achieved with the help of digital tools, for example *Mentimeter*, in which students enter words that they associate with the concept in the word cloud, or by arranging the proposed answers in the correct order. The goal is to attract attention and to motivati by drawing students into interaction and by inciting competitiveness. As well as trying to provide the correct answer, students also want to see who performed best in the class. This part can also be done with the "association" game or solving an initial rebus that will announce the topic of the lesson when the correct answer is guessed.

If it is a new group of students or students from different classes, it is good to use some icebreaking activities at the beginning of the class that will enable better communication within the group and ensure a positive atmosphere of safety and relaxation, which are a prerequisite for the inclusion of students in the process of active learning. One way to introduce team members can be "three true and one false information". Each member of the team introduces himself and says three true things about himself, and invents one, the other students will guess which information is false. So, the goals of using gamification at the beginning of the lesson are: connecting group members into a team, brainstorming, i.e. activating student anticipation about the topic and awakening curiosity about the topic that follows.

Collaborative learning as a modern pedagogical trend aims to train students to cooperate in a team and to develop their personal and social competences. For this purpose, it is good to use the *Scavenger hunt* game. The treasure hunt will allow students to find a solution together and compete with other teams along the way. There are many applications that allow you to implement this game in your teaching process, such as *Taleblazer* (Augemnted reality), LOQUIZ, *Scramboo*, *Eventzee*, *Social Scavenger*, *Huntzz*. Gamification can be realized in the classroom in the tasks that require students to cooperate in designing a scenario for a drama performance or recording video material. In a fun way, students develop their creativity and cooperation in a group. They present a topic by creating a scenario and dramatizing it, i.e. acting, in order to bring the topic closer to other students. If they use technology, they will also develop skills such as editing, video editing, inserting animations, translating and adding subtitles, and the like.

We can use gamification as the central activity during the learning process in a different context and with different learning outcomes. When we ask students to conduct a research on some topic, we could make it more interesting by creating an Escape room. To pass to a higher level, students must explore the topic in more depth with the tasks set for them in the game. The escape room can be used as the central part of teaching, where students, to move to the next level, must study some part of the teaching content and answer the questions correctly or find a key that will enable them to move to a new level. Students are motivated by "success", that is, they are interested in studying the materials to find the solution. Also, if we apply the flipped classroom method, we can ask students to prepare for the topic by playing an Escape room on the given topic, and in this way, they will be informed about what will be covered in depth in class. The escape room can also be used to synthesize the whole or larger part of the teaching content, where students repeat important things from the wider teaching unit and create new connections between data. For older students, especially STEM subjects, one of the tasks can be to create an escape room on a topic assigned by the teacher, which will be the result of independent research on the topic. In this way, they improve their knowledge, not only about the specific content or topic, but they also improve their digital and creative competences. Escape room brings excitement, competitive spirit and joy from solved tasks, and is available to students via their mobile devices.

Another interesting gamification that combines STEM subjects with art and history is City-rally, where students in teams have to find given places in the shortest possible time using orientation, digital tools and cooperation. With physical activity and a competitive element, students can learn new content and develop skills in a fun way.

Elements of gamification, such as collecting points or badges, can be implemented as feedback on student participation in the learning process that lasts for a long time. Student can "earn" points for working continuously on a project, for a special contribution to the project results or for cooperating in a team, which can later be converted into a summative evaluation. Points and badges can affect student's motivation. One example is a very successful platform for learning foreign languages, Duolingo, which uses this method of motivating online learners.

Analysing the responses in the above-mentioned survey in Croatian school, it was observed that the online tool *Kahoot!*, which teachers use to create quizzes, was often mentioned as a tool for repeating teaching content. Due to the simplicity and ease of its use, it is widely used by teachers, regardless of the subject and the age of students. In addition to positive reviews by teachers, *Kahoot!* is also well received by students. The reason for this may be its simplicity of implementation and creation since it is an online application that all students can easily access and answer questions. At the end of the lesson, it contributes to the students' motivation to think critically once again about the teaching contents discussed in the lesson. This part can also be done with the help of other digital quizzes such as *Socrative* or *Learning App*.

No matter in what form and for what purpose you decide to use gamification in your teaching, it is important to keep in mind the main steps in the process of successful implementation:

1. Set up the main criteria of success, i.e., determine the main goal which will be the basis for assessing student's experience as well as what they will be able to do after this educational experience. During the whole process you must be aware of learning goals that you have set.

2. Students need to see their progress all the time either through your feedback, the transition to the next level (e.g., escape room) or through a specific final activity or the end result.

3. Encourage competitive spirit but build a community as well. That is, motivate your students to create team spirit because it is equally important to help others as it is to be better than others.

Literature:

Pofuk , Antonija , *Application gamification in high school teaching* , University of Zagreb , Faculty organizations and informatics , https://urn.nsk.hr/urn:nbn:hr:211:658922

07

How the teacher can motivate and inspire the students to be problem solvers and creative thinkers

Introduction

In previous years it was common to use the teacher-centred frontal teaching method in education. This method is centralized the students passively watch the whole process and the knowledge is memorized. This system increases competition among students, the lesson is not attractive and does not attract their attention. It does not allow them to be creative, does not give them any opportunity to take an active part in the educational process.

By structuring and organising knowledge by areas and disciplines, very often the knowledge is offered without any connection and relationship between them. What is actually presented to the student as a single subject or phenomenon is offered in a fragmented. This means that reality is fragmented into individual pieces of knowledge, which are difficult to form a coherent whole and to be understood by pupils.

The above factors contribute to school drop-out. However, at a time when the acquisition of knowledge and skills is seen as an exclusive protection against social exclusion, and poverty, even the lowest rate of school drop-out would justify the interest and concern of the state. So theoperators who formulate education policy have to pay attention at the learning characteristics and cultural features of all pupils and create the necessary infrastructure for their education.

The teacher is called upon to create the right conditions to motivate all students to learn and discover new knowledge. To achieve this, the teacher should have an understanding of learning theories, to set the objectives, to choose the appropriate teaching method and finally to evaluate the whole educational process for feedback and improvement.

Learning theories

Learning theories are conceptual frameworks that describe how information is absorbed, processed and retained during learning. Cognitive, emotional and environmental influences, as well as prior experience, all play an important role, in how a worldview is understood, or accepted or changed, as well as in the retention of knowledge and skills (Wikipedia).

Constructivism

Constructivism is a theory initiated by Dewey, Piaget, Vygotsky, and Bruner. It borrows some of the ideas of cognitivism, the most basic being the notion that the mind is more than an "unwritten blackboard" that responds to stimuli, and conceives of learning as an ongoing and active process. The learner seeks and tries to solve a problem using pre-existing knowledge.

Principles of constructivism according to Giorgopoulou (2017)

- new knowledge is constructed by students with targeted guidance

- the learner builds the new knowledge

- the classroom is connected to the real world

- new knowledge is linked to the students' experiences

- information is exchanged and compared

- focusing on 'how I learn'

Constructionist theory

Constructionist theory is based on the theory of constructivism. The essence of constructivist theory is the idea that learners must discover and transform complex information on their own (Leinhardt, 1992).

Knowledge is achieved not by collecting and aggregating knowledge from different disciplines but by integrating new data into already formed mental schemas, which means that knowledge must be internalized. According to the same theory, learning must emerge from dealing with problems and situations in everyday life (situated learning). With constructivism students themselves construct new knowledge which is connected to their everyday life (Dickey, 2007) so they can understand the purposefulness of their activities.

It is necessary for the teacher to activate the pre-existing knowledge in order to be able to use it for understanding and learning. Learners do not always understand the relationship between what they are learning and what they already know. Learning is enhanced when teachers pay close attention to the learner's pre-existing knowledge and use it as a starting point for teaching (Vosniadou, 2001).

Social-constructivist theories of knowledge and learning advocate the process of knowledge construction by learners, where experimentation and mistakes in the learning process play a primary role. Several learners learn from the mistakes that they make, especially when they show whether they recognize the mistake, how to recover from the mistake, and how to avoid the mistake in the future (Merrill, 2000).

The main pillars of constructivism are : (Chatzidimitriou 2015)

- knowledge is constructed and not transmitted . Students themselves construct knowledge

- learners build on their prior knowledge to learn

- on the previous knowledge they build new knowledge

In the educational process it means that the teacher through exploratory questions can define the individual abilities and skills of students and also identify the cognitive abilities they can develop (Matsangouras 1997).

Discovery learning

Discovery learning is a learning theory related to constructivism since students on their own seek to rediscover knowledge. The teacher creates the appropriate environment in which the discovery of knowledge is promoted by the students themselves (Makridou –Bouciu, 2005).

According to Bruner, discovery learning is facilitated when the learner develops intrinsic motivation, the main ones being:

- curiosity,

- the desire for achievement,

- the need to interact and cooperate with other students in order to achieve goals.

The teacher should create an appropriate environment for the learner to discover and verify or disprove knowledge through experiments and testing. Such an environment is an interactive environment with computers, simulation systems and modelling (Komis 2004).

Exploratory learning

Exploratory learning has similarities with discovery learning, sometimes these terms are considered to be identical. A teaching which is based on inquiry learning should have the following characteristics:

- be based on analytical thinking

- it must be subject to a logical sequence of gradual building blocks

- the objective of each step must be clear and unambiguous and objective

The role of the teacher is to pose a problem-question to the pupils in a simple and comprehensible way, relevant to their experiences and existing knowledge.

STEM education

The term "STEM" [Science, Technology, Engineering and Mathematics] is the acronym used primarily by people concerned with education policy for the fields of Science, Technology, Engineering and Mathematics.

Science, Technology, Engineering, Technology, Engineering and Mathematics (STEM) applies knowledge and research processes to better understand and impact the world around us.

A prerequisite in the application of STEM methodology is the existence of a problem-solving method. The need for an interdisciplinary approach to Mathematics, Science and Technology, although obvious to many scientists in these disciplines, became more urgent at the beginning of this century.

Moving on to an analysis of the origins of the term STEM the following emerges:

➢Science- S: defined as the study of the physical world and the application of human intelligence to how the world works. The term denotes the system of knowledge acquisition based on scientific methodology based on scientific research, and the organization and classification of the knowledge thus acquired.

➢ Technology- T: has an interdependent relationship with Science and Mathematics and helps control what happens in the world. As defined by the American Association for the Advancement of Science (AAAS), "In the broadest sense, technology extends our abilities to change the world: to cut, shape, or put together materials; to move things from one place to another; to reach further with our hands, our voice, our senses." Technology refers to material objects used by humans to meet everyday needs and includes both tools and machines as well as research, design, management, work, individual pieces that make up a complex social enterprise.

➢Engineering- E: is a science that uses specific processes to identify and solve problems. The Engineering approach uses scientific, technological and mathematical tools to find and implement solutions, following an engineering design, design that is based on thinking, modelling and analysis.

➢ Mathematics- M: is the science of patterns and relationships between quantities, numbers and shapes and which is based on logic and creativity. Mathematics is a language that expresses relationships in science and technology and provides useful analytical tools for scientists and engineers (ASSE, 2010).

Mathematical competence is the ability to develop and apply mathematical thinking and knowledge in order to solve a range of problems in everyday situations. Competence in science refers to the ability and willingness to interpret the physical realm using the body of existing knowledge and applied methodology, including observation and experimentation, in order to identify questions and draw evidence-based conclusions.

STEM education should be defined as an integrated approach to curriculum and teaching. It is an approach that removes the boundaries between particular subjects and sees them as a 'whole', on the basis that contemporary problems are complex and multi-dimensional enough to be addressed by a single discipline. A unified understanding of the components of STEM is vital to a nation's economic competitiveness and the ability of young people to succeed in the 21st century; what is currently lacking in education is "an interdisciplinary approach to learning, where rigorous academic concepts are presented in conjunction with real-world problems."

The knowledge-based economy is driven by continuous innovation. Innovation relies on a dynamic, motivated and well-trained workforce equipped with STEM skills. However, the nature of the workforce and the needs of production have changed over time. Today, an understanding of basic scientific and mathematical principles, a working knowledge of computer hardware and software, and the problem-solving skills developed from courses in a STEM environment are essential skills for most jobs.

According to the Massachusetts Department of Education (2006), eight Engineering Design Process Stages are proposed, which are:

➢Stage 1: Identify the need or problem

➢Stage 2: Researching the need or problem (researching the current state of the problem and existing solutions, exploring other options through the Internet, library, interviews, etc.)

➢Stage 3: Developing possible solutions (brainstorming possible solutions, brainstorming possible solutions, drawing on math and science, formulating-analyzing possible solutions in two and three dimensions, reviewing possible solutions)

➢Stage 4: Selecting the best possible solution (deciding which solution best fits the real need or solves the real problem)

➢Stage 5: Prototyping (modelling the selected solutions in two and three dimensions)

➢Stage 6: Testing and evaluation of solutions (testing whether a solution works, whether it meets the constraints of the original design)

➢Stage 7: Communicating-disseminating solutions (creating an engineered presentation that includes discussion of how the solutions best fit the specific need or problem, discussion of social implications, and sharing of solutions)

➢Stage 8: Redesign (redesign of solutions based on information gathered during testing and presentation.

The role of the teacher

A prerequisite for students to be awakened and to understand the importance of a STEM career is having appropriately qualified teachers who are knowledgeable about STEM-related careers (Nadelson et al., 2013).

- Possess knowledge and experience about the content of STEM practices,

- while teaching methods should be such that they encourage and inspire all students (NRC, 2011).

- Understand the value of collaboration with other teachers in terms of assessing student work,

- be able to help them to understand students' preconceptions or misconceptions and thus make appropriate decisions about how to adapt their teaching (NRC,2012)

According to research results, stem implementation has better results when teacher :

- Has sufficient knowledge of the scientific content

- pedagogical knowledge of the content of the subject matter in order to be able to make instructional reframing

- science, technology, engineering and mathematics must be applied to real-world problems.

Suggestions for the teacher an experiential education

Suggestions for the teacher who wants to develop an experiential lesson according to (Brooks, J. & Brooks, M. 1993):

- Encourage and accept student autonomy and initiative. Teachers should maintain a positive attitude towards the benefits of having diverse groups of learners in their classrooms and adapt learning based on the needs of diverse groups of learners - who, although in the same learning environment, have different learning needs and preferences.

- Strive to use primary sources and information, rather than manipulative learning tools and materials. Understanding the problem and what is needed to investigate it. Generating questions to investigate it. Research by experimentation, modelling, learning from case studies, managing variables, accurate observation and measurement.

- When assigning tasks to students, uses cognitive terminology such as "classify," "analyze," "predict," or "create."

- Seeks out students' prior experiences with a concept before teaching it to them. A teacher with well-developed Content Knowledge Pedagogy can anticipate common student misconceptions and have ways for students to cope with these difficulties, can make connections between different ideas, draw on their prior knowledge, have a variety of teaching approaches in his/her "quiver", and have the flexibility that comes from looking for alternative ways to be able to explain the same idea or problem.

- It encourages communication between the teacher and the pupils, and between the pupils themselves. They should be able to apply appropriate classroom management strategies and conflict resolution and bullying prevention techniques, as well as have expertise in interpersonal skills to promote a positive school and classroom climate. The teacher, through a supportive communication framework, should enhance the self-esteem of his/her students. Positive self-esteem helps to strengthen self-image and helps the individual to view himself/herself and others positively, to handle failures with composure, to be aware of his/her weaknesses and to try to correct them.

- Encourage students' critical thinking by asking open-ended questions and encouraging them to ask each other questions. Scientific knowledge is developed, not in the sense of a cumulative increase in encyclopaedic knowledge, since all such knowledge is revisable and uncertain. Scientific knowledge develops if it is understood as an ongoing and uninterrupted critical discussion, which is constantly rising in quality, to the extent that it is indeed critical.

- It asks additional questions, working on the students' initial response. She uses probing questions, asking for clarification or seeking fuller understanding (e.g., "Could you give an example?", "Could you tell your classmates how you thought to arrive at this conclusion?"), paraphrasing students' words, intervening when and where she feels there is a need (e.g., "So you mean to say that....", "You mean that....", "You are of the opinion that...").

- Introduces students to situations that contradict their prior understandings and that create contrasts that encourage discussion. The emergence of ideas can be achieved through discussion, questionnaires, individual work, hypothetical experiments (where children are asked to predict the results), concept maps, etc.

- Giving students enough time when asking a question so that students, have time to think about their answers and respond after thinking.

- Gives students time to create their own interpretation when learning something new. Students are asked to test their ideas in order to expand on them, develop ideas if they didn't have them before, or replace them. An important role is played by comparing the results of the experiment with the predictions. Children work in small groups and carry out experiments. Finally, they try to interpret the results. The aim is to get the children to 'deadlock' and ask themselves why their ideas do not match the results of the experiments. This may lead them to conceptual change and adopt the ideas that are in line with the scientific model.

However, a prerequisite for achieving school effectiveness is the lifelong development of teachers. These skills are not innate, but are developed through continuous learning through a combination of education and training, practical experience and personal, systematic effort.

Skills and practices for each STEM discipline.

Teachers who are called upon to teach STEM will need to collaborate with each other and with external institutions. This requires communication skills from them. Skills that will enable them to interact effectively both with each other and with stakeholders will need to have the skills, willingness to collaborate and creativity required to secure the involvement of external stakeholders, including employers in the local community.

Skills and practices for science

➢Understanding of a problem and what is needed to investigate it. Generating questions for investigation,

➢ Research by experimentation, modelling, learning from case studies, managing variables, accurate observation and measurement.

➢ Informed decision making, reporting reasoned conclusions.

➢Repeatability for reliability of measurements.

➢Scientific explanation.

➢Research design.

➢ Communication of ideas, results, interpretations, implications, rationale, explanations, principles.

➢Teamwork Collaboration with all groups

Skills and practices for Technology

➢Identify constraint criteria and problem specification

➢Management and understanding of materials

➢Research for the purpose of application design and 'running models' study and learning from case studies.

➢Thorough decision making reporting reasoned design decisions.

➢Iteration towards an optimal solution.

➢Explanation of failures and recommendations for improvement.

➢Prioritizing criteria, sharing criteria with each other for optimization.

➢ Communication of ideas, design decisions, rationales, explanations, empirical design rules.

➢Group work collaboration with all groups.

Regarding the available robotics products, there are two different types of products that can be used in engineering and technology educational interventions for young learners: (1) programmable toys that do not require students to build but allow them to proceed directly to programming and (2) robot kits, which give students the opportunity to first build a robot and then program it (Çetin & Demircan, 2020).

Skills and practices for mathematics

➢Understanding the problem and persevering to solve it. The most proficient students in mathematics explain data and questions of the problem and look for evidence to solve it.

➢Logical and deductive thinking. Students can create abstract structures of a situation, represent it with symbols, and then manipulate it.

➢Construct viable arguments and critique the reasoning of others.

➢Modeling with mathematics.

➢Accuracy of wording.

➢Searching for and using structures - patterns - patterns.

➢ Search for and expression of regularity with repetitive reasoning.

➢ Use of algorithms.

Mathematical and computational thinking is integral to design, allowing engineers to run tests and use mathematical models to evaluate the performance of a design solution before creating patterns. Use of computational experiment methodology.

Didactic design

Didactic design refers to the systematic planning and organization of educational materials and teaching methods in order to facilitate learning. It involves designing learning experiences and materials that are effective, efficient, and engaging for learners. The goal of didactic design is to help learners acquire knowledge, skills, and attitudes in a way that is meaningful and relevant to them. This can involve creating lesson plans, selecting and organizing content, designing assessments, and choosing appropriate teaching methods and technologies to support learning.

Teachers work to create learning experiences that are engaging, effective, and aligned with the goals and objectives of the educational program or institution. They may use a variety of tools and techniques, including instructional design principles, multimedia resources, and interactive elements, to create materials that are tailored to the needs and learning styles of their intended audience.

A didactic model is a method or approach to teaching that is designed to help students learn and understand a subject more effectively. It is based on the idea that the best way to learn something is through direct, hands-on experience, rather than simply being told about it or reading about it. Didactic models are often used in education to help students gain a deeper understanding of a subject and to develop critical thinking skills. They may involve interactive activities, problem-based learning, or other approaches that actively engage students in the learning process.

According to the theory of Hough (1967), didactic design is a process that involves a series of activities and actions that are implemented in a logical way in different phases such as

a) the curriculum design phase

b) the instructional intervention phase and

c) the evaluation phase.

As learning is a complex process, the teacher must utilize learning theories and come up with specific teaching strategies. Instructional models differ from instructional strategies as they are designed to achieve specific objectives rather than general objectives

Didactic models are derived either from classroom experiences or from theories in a coherent form taking into account learning theories or from hypotheses but a characteristic of all didactic models is that they must always refer to learning outcomes and specific cognitive objectives and competences – skills.

There are several categories of didactic models. Didactic models design classified into families according to their philosophical epistemological phase and learning outcomes are including:

1. Behavioral models, which focus on the observable actions of a learner and how they respond to different stimuli.
2. Cognitive models, which focus on the mental processes involved in learning, such as attention, memory, and problem-solving.
3. Constructivist models, which emphasize the active role of the learner in constructing their own understanding of new concepts.
4. Constructivist models, which emphasize the importance of networks and connections in learning.
5. Humanistic models, which focus on the individual learner's personal growth and self- actualization.

Didactic models can also be classified according to their instructional methods, such as direct instruction, inquiry-based learning, and problem-based learning.

Problem based learning –PBL

Problem solving is a teaching model where there is interaction between the teacher and the learner while the goal of the lesson is always the application of knowledge and problem solving.

Problem solving is a teaching and curriculum approach that has been successfully applied over the last 40 years and has been accepted in many subject areas. Problem solving integrates theory and practice and utilizes knowledge and skills to achieve a solution to a problem.

Problem solving is epistemologically linked to constructivist epistemology as it considers that learners connect their experience through problem solving with the construction of new ones, and high-level skills such as critical and creative thinking are also fostered.

Problem solving is also seen as a teaching model that uses problems, often of an interdisciplinary nature, as a motivation for learning.

According to Jonassen (1997) structured problems require the use of a number of concepts to solve them. Such problems are found in textbooks and in exams. Unstructured problems are complex problems that cannot be solved by simply applying an algorithm or a specific type of action. They require learners to find alternative solutions and logical arguments to support the solution they propose. The formulation of hypotheses is important. In addition in problem solving, learners have the opportunity to develop logical reasoning and self-regulation skills through restating hypotheses and rechecking data.

A key component of the problem solving method is the selection of appropriate problems often interdisciplinary. The teacher guides the learning process in such a way that the learner is engaged in a discovery process by formulating correct hypotheses.

Definition of the problem

Several analysts have attempted to define the concept of problem according to Heidbreder (1952 as referred Minder 2007), the problem is a psychological situation that does not impose on the person the answer but requires him to discover through his action some more characteristics. According to the study of Maridaki-Kassotaki (2011) the problem is a situation that in order to be addressed it is not enough to utilize the already existing cognitive background this happens because it needs creative utilization even a combination of previous experiences.

In our everyday life we face many problems that we are called upon to solve and they differ from each other. There are differences in the types of problems and they are presented either from psychology or from the perspective of pedagogy, but all problems are based on a basic criterion in whether the solver is provided with the necessary information to solve the problem or is required to produce it himself, so they are distinguished into closed and productive problems based on the mood of the solver.

The problems used in teaching

The problems used in teaching retain the general characteristics of the problem but are adapted to the educational context. It is important to point out that in learning organized around a problem (PBL), emphasis is placed on the need to exploit the teaching of problems that do not limit students and are amenable to multiple answers.

The problems posed in teaching from Pisa in 2003 study by the OECD on mathematics, the reading of science and the ability to solve problems in order to determine whether students can apply what they learn in everyday situations, as the theoretical framework of problem solving was established their basic characteristics were formulated in three types: a) decision-making b) problem solving c) troubleshooting.

Why students should solve problems

There are several reasons why it is important for students to solve problems:

1 Problem solving helps students develop critical thinking and reasoning skills. It encourages them to think creatively and to analyze and evaluate information in order to come up with solutions to problems.
2 Solving problems helps students learn how to apply what they have learned in the classroom to real-world situations. This helps them understand the relevance and value of their education.
3 Problem solving promotes self-motivation and self-directed learning. When students are able to successfully solve problems on their own, it can give them a sense of accomplishment and encourage them to take on more challenging problems in the future
4 Problem solving is a key skill in many careers. By solving problems while they are still in school, students can develop the skills they will need to succeed in their future jobs.
5 Problem solving helps students learn how to work well in teams. When students work together to solve problems, they learn how to communicate, collaborate, and compromise, which are all important skills in the workforce.

Compilation of model (PBL)

Researchers have proceeded to create problem-solving models each of which consists of a set of strategies**.** In this paper are presented in detail two models of Suchman and Poyla.

Model of Suchman

According to J. Suchman (1962) as referred in Joyce & Well (1986) the solution of problems with realistic authentic content depends on internal and external representations and on direct interaction with the real world and the environment. Learning is implemented through questions but does not focus on the correctness of the answer but on the exploration of alternative solutions to a question a problem. Students learn through their involvement in identifying the problem, exploring the use of information to solve the problem, developing ideas using research methods such as scientists.

The phases and the workflow of teaching with this model are described below:

First phase: choosing the problem and conducting the research.

The teacher starts the lesson by choosing a strange/ problematic problem. The term strange/problematic corresponds to a non-standard problem that is related to real phenomena.

The choice of the problem is such that it corresponds to several subject areas.

Students are asked to find a logical solution which is linked to dimensions of computational thinking.

The students are involved in the scientific method.

The teacher prepares the data that will be needed for the solution.

Second phase: data collection

Students ask questions in the form of hypotheses.

The teacher answers the question either affirmatively or negatively or asks for rewording the questions

Students collect data which they record on worksheets or software.

Third phase: theory development and verification

Students can formulate a theory that will answer the problem

The rest of the class accepts or rejects the theory

If the theory is accepted then starts a deeper dialogue about causal relationships alternative hypotheses and so on.

Fourth phase: explanation of the theory and «rules»

Students propose a method for verifying the "theory"

If a mistake is found in the explanation, they refer to the data and hypotheses

Final formulation of rules and explanations

Fifth phase analysis of the process

Review by students of the process followed

Discussion of possibly more effective strategies reflective processes ('metacognitivism').

Model of Poyla.

Poyla (1957) considers problem solving a fundamental skill and distinguishes four stages. The first stage involves the conceptual understanding of the problem, the second involves devising a solution plan, the third involves executing the plan and the fourth involves reviewing the solution and verifying it.

More specifically, the stages of Poyla include the following:

Devise a solution plan to search for a relationship between data and requested with direct correlation or with auxiliary problems

1. Have you encountered this problem before? Have you encountered the same problem with another form?
2. Do you know a related problem? Do you know a relevant theorem related to the problem? (this strategy is called heuristic and is a general strategy independent of the problem).
3. Think again about the problem and consider a problem that you are familiar with, which is relevant to the problem you have been given.
4. You are presented with a problem related to your own, that you have already solved, can you use it? Can you use its results or method? If an auxiliary element is introduced can you make it possible to use it? The authors consider this point

to be quite difficult because it is linked to the formulation of hypotheses and in any case it needs guidance from the teacher; for incorrect auxiliary elements.

5. If you can't solve the problem can you think another one related to that, or another more general problem, or more specific that you could solve? Could you solve a part of it? Could you keep a part of the given conditions and comment on whether the requested parts can be identified with the section of condition?
6. Could you extract something usable from the data? Could you think of other data that would be more useful or more suitable for determining what is requested? Could you change the data or the requested or both so that the requested and the data are closer to each other?
7. Have you used all the data and all the condition you have taken and all the fundamental concepts link to the didactic model involved in the problem?

Implementation of the project

When executing the plan to review the correctness of each step also think about whether the step is reasonable. Can you prove that the step is correct?

Review

How would you check the result, whether it refers to theoretical proof or "proof" through the use of measurements?

How would you check the logical justification?

Can you think of a different alternative with the same data?

Can you generalize it using the solution method for other problems?

It is obvious that in the review metacognitive functions and dimensions of computational thinking are activated in the problem solving method, the trainees work individually or in small groups to study realistic problems to identify the data needed to solve the problem.

Cognitive Goals according to Bloom

All models include in addition to the syntax and goals. In this paper is quoted the model of Bloom (1971) According to this model there are three types of goals

Cognitive: cognitive objectives refer to knowledge about concepts, constructions and so on, understanding and critical thinking about a subject of a cognitive area.

Effective: emotional goals refer to the development of attitudes of feelings appreciations, internal motivation regarding learning .

Psychomotor: psychomotor refer to the development of skills related to handling, design, manufacturing, assembly and so on.

A summary of cognitive objectives according to Bloom

1) **Knowledge:** The student recalls basic knowledge and information that he has learned remembers facts, terminology, basic concepts. Knowledge may be

linked to the abstract process in which case it could be linked to computational thinking.

Commonly used verbs: mention, formulate, define, drop, select, enumerate, describe, assign etc.

2) **Understanding:** The student understands facts and concepts identifies common points in concepts, organizing, comparing, interpreting, describing and correlating the main concepts, while also connecting concepts with each other. It can also distinguish patterns and connect general concepts with concepts with more restrictive content.

Commonly used verbs: compare, correlate, prove, interpret, explain, depict, describe, categorize, rephrase, clarify, etc.

3) **Application:** The student solves problems by applying the acquired knowledge by scientific method, methodology, designs, constructs.

Commonly used verbs: apply, calculate, develop, perform a process, organize, construct, develop, use, select, design, model, discover, etc.

4) **Analysis:** The student examines and analyzes information in smaller parts- parts based on criteria or simpler structures. He concludes and finds evidence to come up with generalizations.

Commonly used verbs: analyze, categorize, compare, find various, discover differences in simpler parts, distinguish, record data, conclude, etc.

5) **Evaluation:** The student presents and defends opinions/judgments, judging the information and data available, checking the validity of concepts or the quality of a work based on a series of criteria. It can still evaluate a build.

Commonly used verbs: conclude, classify, argue, evaluate document, compare, rate, support, prove, disprove, reflect, review, etc.

6) **Synthesis – creation:** The student gathers information in different ways (eg from virtual representations or from simulation results) combining them to formulate a solution or to design and create a construction.

Commonly used verbs: compose, combine, improve, create, make, develop, form, invent, predict, generalize, etc.

Soft skills that the students developed solving problems

There are many soft skills that students can develop by working on problem-based solutions. Some of these skills are:

Critical thinking skills: Students are required to think critically and creatively in order to solve complex problems.

Critical thinking is a mental process that involves carefully and systematically analyzing, evaluating, and synthesizing information in order to make well-informed decisions. It is a way of thinking that involves actively questioning and examining ideas and arguments, considering multiple perspectives, and using logical reasoning to arrive at a well-supported conclusion. Critical thinking skills are important because they help individuals to effectively evaluate information and make sound decisions. These skills are valuable in many different settings, including academic, professional, and personal contexts.

Critical thinking is a process of actively and objectively evaluating information, arguments, and evidence to make decisions, solve problems, and communicate effectively. Problem solving is an important aspect of critical thinking because it requires you to use your critical thinking skills to identify the problem, gather and analyze information, and come up with a solution. By going through this process, you can develop and improve your critical thinking skills, including problem-solving, decision-making, and analysis. As you practice and apply your critical thinking skills to different problems, you can become more effective at evaluating and synthesizing information, formulating and testing hypotheses, and making sound judgments.

> Communication skills: Students learn to effectively communicate their ideas and solutions to others, both verbally and in writing.

Communication skills are the ability to effectively exchange information, ideas, and thoughts with others through speaking, writing, and listening. These skills are important in all aspects of life, as they allow us to convey our thoughts, ideas, and feelings to others, and to understand the thoughts, ideas, and feelings of others. Good communication skills can also help to build strong relationships, solve problems, and achieve your goals.

> Collaboration skills: Working on problem-based solutions often requires students to collaborate with others, which can help them develop teamwork skills

Collaboration skills refer to the ability to work effectively with others to achieve a common goal. Developing strong collaboration skills can be beneficial for both personal and professional success. They can help you work more efficiently with others, build strong relationships, and achieve your goals..

> Time management skills: Working on problem-based solutions often requires students to manage their time effectively in order to complete tasks and meet deadlines.

Time management skills refer to the ability to use one's time effectively or efficiently. Good time management skills can help you prioritize tasks, meet deadlines, and achieve goals. It's important to remember that time management is a skill that can be developed and improved with practice.

> Leadership skills: Students may have the opportunity to take on leadership roles as they work on problem-based solutions, helping them to develop leadership.

Leadership skills are abilities that enable students to guide and motivate a group of people to achieve a common goal. Some examples of leadership skills include communication, decision-making, problem-solving, strategic planning, delegation, and the ability to build and maintain relationships. Developing leadership skills can be beneficial in a variety of settings, including in the workplace, in community organizations, and in personal relationships.

Creative skills: Problem -solving gives the ability to the students to find creative solutions or challenges.

Creativity is the ability to produce new and innovative ideas or things. It involves using your imagination and originality to generate novel ideas, approaches, or solutions to problems. Creativity is a valuable skill that can be applied in many different fields, including art, science, business, and more. There are many ways to foster creativity, including setting aside dedicated time for creative pursuits, surrounding with creative people, and engaging in activities that challenge students to think in new and innovative ways.

All the above skills are the skills that the market needs to apply for a job. By developing their soft skills, young people can increase their chances of finding a job and avoid social exclusion and poverty.

Conclusions - Proposals

STEM education is a pedagogical model based on interdisciplinarity, inquiry and experiential learning, teamwork, combined thinking and problem-based learning (PBL), with students at the centre.

Teamwork is essential. A class that functions as a team seeks to achieve common goals and participates in the joint effort to achieve them, to solve a common problem, and each member of the team communicates directly with all other members of the team.

The problem-based learning (PBL) didactic model offers a lot of opportunities to the students. Is a teaching method that focuses on the acquisition of knowledge through the experience of solving real-world problems. It is a student-centered approach that encourages learners to be active and collaborative in their own learning process.

Increased motivation and engagement, PBL allows students to learn by doing and applying what they have learned to real-world problems, which can be more engaging and motivating than traditional lectures or readings. Enhanced critical thinking and problem-solving skills as PBL requires students to analyze, synthesize, and apply knowledge to solve problems, which can help them develop critical thinking and problem-solving skills.

Improved collaboration and communication skills as PBL encourages students to work in teams and communicate with each other to solve problems, which can help them develop collaboration and communication skills, Research has shown that students who learn through PBL tend to retain more of what they have learned compared to those who learn through traditional methods. Overall PBL can be a very effective teaching method that offers many opportunities for students to learn and grow. The method can be used very successfully in STEM education.

This requires institutional arrangements for more flexible curricula to enrich the school experience with parallel STEM activities, but also to promote collaboration with the extracurricular environment.

Training of teachers on STEM issues is considered necessary both on a theoretical and practical level in order for them to adopt a more positive and proactive attitude. Another critical element that training programmes should include is the need to develop evaluation methods and tools for integrated STEAM training (Aydin, 2020; Dong et al., 2020). Here there is the possibility of focusing on learning products, the tangible outcomes, i.e., the learning activities that students construct during learning activities, which can be stored and recalled for evaluation purposes (Hovardas, 2016).

Redesign the curricula of primary and secondary education (and vocational education and training) with an emphasis on STEM, creating modern educational material, using technology in school education, modern logistical infrastructure and upgrading school vocational guidance.

It has been pointed out in several studies that the demands of integrated STEM education are much greater than those of a single scientific field. The time to be invested in designing an integrated STEM education course compared to the time required to design a course in individual STEM fields is much longer (Ryu et al., 2019) and with the workload of teachers this is a major disincentive to implement integrated STEM courses (Ryu et al., 2019). Therefore, teachers need to be incentivized to engage with this.

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08

Implementation advice how to choose a curriculum, design and adapt interactive lessons plans, templates for several activities that keep students involved and make learning fun.

8.1. SPAIN.

The introduction of gamification in the classroom requires basic knowledge on the part of teachers, as well as knowledge of the different tools needed and strategies for converting the traditional classroom into a gamified classroom.
The following is a description of each of these elements that make up the gamification process in an educational centre.

1- What is gamification?

Gamification is a technique that allows the use of various resources and tools in the classroom that will help teachers to motivate students, personalise activities and content according to the needs of each student, favour the acquisition of knowledge and improve attention.

Different types of gamification can be distinguished, depending on the people involved in each of them.

a) At classroom or area level; this is the simplest type of gamification. It can be used for an assessment, a specific activity, a unit, or as an initial activity to motivate students around a topic.

b) At stage level; this involves more participants and seeks to ensure that the whole educational stage works along the same lines and in a coordinated manner.

c) At school level; this is the type of gamification in which the collaboration and involvement of the entire school staff is needed. It makes the most sense, as when something is worked on at school level it becomes part of a school project and is no longer an isolated action.

d) As a shared project; this is a very rewarding type of gamification because it is carried out with the involvement of different agents, teachers and schools. It works at an inter-school collaborative level. It can be a reading project, a conflict resolution project, a mathematics project, etc. This type of project is greatly enriched through the contributions and participation of the different members of the educational community. This is the case, for example, of the project *Lecturas por Sonrisas*, shared by more than one hundred educational centres with the aim of encouraging interest in reading, which can be viewed at the following links (only Spanish webs):

Project **Video**

2- What are the **benefits of gamification for students and teachers?**

There are many benefits, including the following:
a) Motivation. Gamification increases motivation for learning. Children love games, so any activity that they find fun increases their motivation. In reality, motivation is not directly proportional to learning, but it is clear that these tools increase their willingness to learn and do not generate rejection as the traditional learning concept might imply.

b) Adaptability. Each game is designed with a series of challenges and objectives that students must achieve. The essence of gamification can be similar to that of a video game: as the player progresses through the levels, the game becomes more difficult. This can be, for example, the assimilation of more abstract concepts or more difficult problems to solve. The level of difficulty has no limits and can be used at all educational stages.

c) Transversality. The concept of the traditional classroom with books and notebooks can be uninspiring for students. On many occasions they do not find meaning in the concepts they are taught, and this makes them feel demotivated or find the subjects boring. Gamification can be applied in all subjects, from Mathematics to Social Sciences or Music, and through it they can understand abstract concepts in a more practical way.

d) Knowledge. Gamification favours the acquisition of knowledge, which is directly related to the students' interest in and understanding of the concepts. There are complex concepts that students are not able to understand and, therefore, when it comes to studying, they are unable to assimilate them. Through gamification, both simple and complex concepts can be learned and it is easier for children to understand them and learn them in a meaningful way.

e) Attention and concentration. The gamification process is like a chain: if the children are motivated, feel that they are capable of understanding the concepts, are challenged and like them, they themselves will put all their attention and concentration into continuing with it, focusing all their efforts and resources on the game and favouring their own learning.

f) Problem solving. It involves an improvement in the use of logic and strategy in problem solving. This is a fundamental characteristic of any educational game. Challenges are posed and pupils have to think to solve them. It may be a trivia game, a mathematical puzzle or a strategy that requires knowledge of physics, but the common feature is that they all require the use of logical thinking and learning by deduction and trial and error.

g) Cooperation. Gamification stimulates social relations, as most gamification tools require that they are used in groups. In this way, students have to learn to communicate and work together to achieve the objective. This type of game encourages each student to take on a role in the game, while also seeing their peers as equals.

h) Responsibility. Gamification bases its structure on video games and games with an educational intention that makes children understand that they are not just a simple leisure tool, but that each game has a purpose, a series of rules to follow, strategies to develop in order to achieve the final objective and that they can also make moderate and responsible use of all of this. All of this helps pupils to develop positive civic attitudes towards coexistence in society.

i) ICT. Encourages the use of new technologies. Gamification can be carried out with or without new technologies, but there are great technological tools such as educational robotics or the design or development of video games that make students start to use new technologies and integrate them into their way of learning and living.

3-How can this technique be carried out and applied in the educational centre?

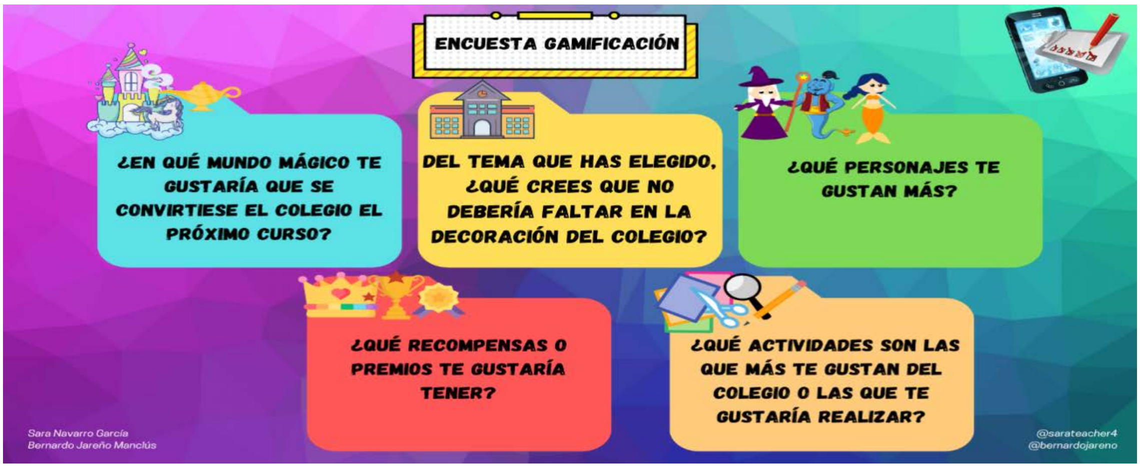
First of all, you should start by motivating the teaching staff, making them experience first-hand what gamification is. To generate this motivation, you can prepare an escape room, a gymkhana or a clue hunt, and, once they have enjoyed this experience, you will awaken their interest in this fantastic technique that is captivating more and more people.

In this first phase of motivation, it is essential to accompany and advise teachers, creating confidence and determination in them. This process can be done by means of an accompanying tutor, i.e. a person who uses and masters gamification and who can accompany the people who are starting out in this process to provide them with all the help they need. Another option is to have a small library of books on gamification that teachers can consult. In this sense, the final bibliography includes a list of works that could form part of this collection of reference works.
In addition to consulting these types of works, it is also advisable to follow social networks of teachers who share their experiences, as well as Telegram groups where communities of teachers give their opinions and help each other with different projects; it is also beneficial to watch YouTube videos from different channels on gamification, as is the case of those linked below.

Gamifying Teacher **Sandbox Education**

Secondly, once interest has been aroused in the teaching staff, it is time to start working with the students.
This phase of the process should start with the knowledge of the students' interests, a key element to plan the gamification strategy. This phase can be carried out by means of a debate, a survey, a discussion, etc. It is important to note that the chosen topic should always be appropriate for the learners, as any topic that is mocking, disrespectful or inappropriate should be discarded.
Digitised survey tools such as Google Forms and Mentimeter can be used for this task. These applications allow questions to be asked through electronic devices that can be answered individually or as a group in class. In this way, the results are saved and can be consulted at any time. An example of a survey can be seen below (only in Spanish):

GoogleForms **Mentimeter**



Once the interests of the different classes are known, it is necessary for the school staff to meet and share them; the one with the most votes will be the one chosen to carry out the gamification. Afterwards, the pupils' choice must be approved by the school staff and the school council in order to make the process official.
The selected topic will not be communicated to the students until the start of the gamification project, in order to generate a curiosity that keeps them motivated and interested even before the start of the project.
The choice of subject matter may generate doubts about the attitude and predisposition of students who were not in favour of this choice. The majority of these students usually end up agreeing to the project with interest, mainly due to the need to bond with the group and remain in it, a behaviour that is inherent to human and social beings.

4.- Components of the gamification project

Narrative creation

The narrative is the central concept or idea around which the whole project revolves. It must be attractive, motivating and allow the teacher to have a wide range of possibilities for preparing the resources. To this end, the teacher's imaginative ability to design a script that meets the above-mentioned requirements is key.
This narrative should take into account the following aspects:
a) The story most voted by the students.
b) Pupils' favourite characters.
From the different desired narratives, they will be asked which characters they would like to see appear. In addition, it should be taken into account which characters appear most often or are repeated among the pupils.
c) Selection of the villain to be overcome.
Like most stories or video games, there is almost always a villain to defeat.
d) The object to be recovered.

It can be an object, relic, parchment, magic key, etc. The selection of this object must allow the students to advance in the game process. This object to be recovered or obtained will be detailed later in the quests section.
Once these elements have been defined, the narrative of the gamification project can begin to be created. This can be developed using digital platforms such as Genial.ly or Canva. In addition, the use of digital resources made with video editors or 3D object generators can help to make the project as realistic as possible. In case it needs to be adapted for lower grades or lower levels, this can be done through drama, storytelling or puppetry.
Let's look at some examples:

Disney Sax School" **"Harry Potter's School"** **"Disney Sax School"**

The avatars

Avatars allow students to be part of the gamification by creating an emotional bond between students and their avatars. In this way, they see their progress in the game as their own, which motivates them to keep moving forward and to care about what happens to their avatars.
At this stage of the process you should select the avatars that will accompany you in the story, bearing in mind that it is important to select as many avatars as rewards you can obtain. To do this, it is advisable to take into account their interests and the results of the survey to select them.
Key to the design of avatars is the sequencing of the avatars. Thus, at the beginning they should be obtained with few points to increase motivation and then this range of points will progressively be more extensive. This is the dynamic used in video games. The first few screens are usually quite fast and easy to overcome in order to provoke a sense of progress and satisfaction, even if it takes them a little longer to progress afterwards. If at some point they feel stuck and feel like giving up, they will see that they have already passed many levels or screens and that they are getting closer and closer to the end and, therefore, it is worthwhile to keep trying a little harder to achieve it and not give up trying. Gamification works in the same way, at the beginning the avatars will overcome them quite quickly and later on they will find it harder and harder. In addition, it is important to sequence the rewards so that they become more and more interesting for the students, as happens with video games, where the different items that they obtain have more and more powers. The best rewards or objects to get will be at the end of the project.
In addition, with regard to the avatars, it is important to alternate male and female characters in order to work on coeducation and positive values.
The following example shows how avatars are designed.

Avatars "Disney Sax School".

Functioning of the scoring dynamics

It is important to bear in mind a fundamental aspect of how this dynamic works. There is no basic functioning that is immovable, it can be modified and adapted to the needs of the pupils, even differentiating between the functioning of infants, primary and secondary school. In any case, it is advisable to make modifications every year in order to surprise the pupils.

The establishment of the scoring dynamics should revolve first and foremost around the students' attitude towards the project. Thus, they can accumulate positive points for their work and behaviour, and lose them for inappropriate behaviour. For example, they can receive 5 positive points if they help their classmates, or 2 if they give an explanation to the class of the contents being worked on; on the other hand, if they disrespect a classmate, they can receive 5 negative points, or 2 if they mistreat classroom material.

On the other hand, an alternative way of configuring how the scoring works is to establish the attainment of positive points if they achieve the curricular objectives proposed by the teachers, or to lose them for not completing tasks, always taking into account the different learning rhythms of the class. For example, if they carry out the proposed extra activities, they can obtain 3 positive points, but if they do not carry out the assigned task, they can receive 3 negative points.

In establishing this dynamic, it is necessary to reach a consensus in the cloister in order to put points in common, so that the students have the same possibilities of making progress. Likewise, each tutor or specialist will be able to put his or her own points apart from those agreed upon in order to reward those aspects that he or she believes should be improved.

For score management, there are several digital tools that are often very popular with students, as they are visual and attractive. Some of them are linked below:

Classdojo **MyClassGame** **ClassCraft**

In the case of opting for the use of these tools, the data protection law must be taken into account. Thus, students' names and surnames should not be used, but rather pseudonyms; likewise, students' photographs should not be uploaded and communication with families should not be established through these platforms.

In the case of not making use of these platforms, this can be done in an analogue way through manual records with posters, progress lines, etc.

Rewards

They are rewards for overcoming a challenge, achieving a goal or carrying out a desired action. They provoke in the students the feeling of joy that a player gets when he/she achieves a goal. In order to put them into practice, all students start with 0 points and the same avatar. As they earn points, they obtain avatars and each of them is assigned a reward.

It is advisable to use individual, small group and class rewards, with the intention of encouraging companionship and avoiding competition, as the progress of each student is beneficial for the rest of the class. It is advisable that these cards are numbered in the same order as the avatars to avoid confusion and, above all, to sequence the rewards in an increasingly attractive way.
There are a multitude of tools for creating reward cards, as can be seen in the following example.

Presentation Letters

Rewards can be of different types:
a) Diploma / Certificate: issued to the person indicating that an objective has been achieved.
b) Status: accumulable points that allow for promotion in a ranking or leveling up.
(c) Boosting object: they grant extra privileges.
d) Badge: rewards that indicate that a goal has been achieved.
Some examples of these types are shown below.

League of Wisdom" Cards

"Pokémon Sax Camp" Cards

The missions

Missions are key elements within the project to understand the main objective of gamification. They maintain the level of interest and motivation of the students, and allow them to review curricular content in a playful and purposeful way.
Missions are carried out on a monthly basis, and, if successful, provide a key, a badge, an egg, etc. They can be adapted and carried out at the end of a unit, a project or on a specific date, such as certain holidays.
Missions should have a certain structure. First of all, a poster should be made a week before and put up at the school door or somewhere visible to the pupils, which will arouse their interest. Then, before starting the mission, the pupils are told what their mission will consist of. To do this, a video will be shown, a text will be read or it will be explained orally. An example of this can be seen in the following link.

Video IntroductionMission

Thirdly, it is important to vary the mission materials so as not to create monotony; many dynamics can be used, including BreakOut Edu, QR code searches, map quests, gymkhanas, etc.
Finally, these missions should connect students with their context, so that they interact with it and generate memories and emotions. To this end, it is important to have volunteers to help in the project, or collaborations with organisations such as the Red Cross, Civil Protection, Local Police, or any other organisation through which the connection of the project with the reality close to the students is encouraged. Some examples of this can be found in the following links:

Video missions

Structure Mission

The setting

Once the gamification has been created, it is necessary to focus on preparing the decoration and ambience of the centre in accordance with the project. It is essential that the experience is as immersive as possible to promote the credibility of the project. To this end, it is advisable to welcome students on the first day of class with the teachers in costume, the centre fully decorated and the music themed. With this setting, the presentation of the narrative and the explanation of gamification will be much more motivating. Below you can see an example of how to set the scene for a gamification project.

Ambience Video

Gamification tricks
The tricks can have different functions, but fundamentally they seek to consolidate project objectives, adapt them to the diversity of learners and their abilities, and enhance the competences that learners need to develop. The following tricks are an extract from Michael Matera's book, *Explore like a pirate*, published by Mensajero.

a) The guilds
Guilds are small groups of people who are assigned a fancy name according to the gamified structure. They create group cohesion on the one hand, and shared experiences on the other. This helps everyone to get involved in the game and in this way, some can help others who have lower levels to level up.

b) The life jacket
This trick allows you to recover those students who have lost interest or become unmotivated. To do this, it is necessary to reinforce and prioritise those qualities that they are best at in order to reintroduce them into the dynamic. For example, if a student is absent and has few points compared to his or her classmates, we will try to assign points for work that he or she can do more easily.

c) The Guardian
At the start of the unit, each group is given a card with the collective objective to be achieved. If at the end of the unit everyone achieves it, there will be a reward.

d) Guild fighting
Guild wrestling is an activity that serves to consolidate the skills that have been worked on. Each group is a guild, and through games such as Baamboozle, Quizizz or Kahoot, they compete against each other, while at the same time consolidating the skills they have developed.
In the following link you can see a complete example of a gamified structure:

Gamified Structure

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Matera, Michael (2021): Explore like a Pirate. Messenger.
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City - rally Zagreb

City rally is a game in which students are divided into groups/teams with clearly stated tasks. The goal is to connect students, complete tasks and have fun while doing so.
The activity begins by dividing the students into groups and giving clear instructions (mandatory taking a photo in front of a landmark, means of transport and the map of the route, making a video or a presentation, etc.) and limitations (for example, time). After the introductory part, students divide tasks among themselves in groups and develop a strategy to complete all tasks within a certain time frame. At the end of the activity, the students, in already existing groups, should create a video or a presentation to demonstrate and confirm that they have completed all the assigned tasks. The students who completed the activity the fastest, as well as those who created the video or presentation in the most creative way, will be evaluated.

Authors:	Željka Winkler
Subjects:	Geography, History of art, English language, Physical and Health culture, Informatics
Description of activities:	The activity is aimed at developing the skills of orientation, time management, teamwork and exploring a new location/city. Instead of a typical guided tour of Zagreb, students are divided into (international) teams and have tasks to complete: at each point/location they need to visit, they have a task and need to take pictures or record themselves. In this way, they are engaged and activated during the entire process, and by researching and completing tasks, they get to know the given location better and develop their skills. The activity has a game element, as the tasks must be completed in the shortest possible time, and the group that completes all the tasks first, i.e. visits all the locations and takes a short video or photo at each location as proof of the task's completion, wins.
Outcomes:	- students will practice orientation using a digital or physical map - students will estimate the distances and time required and devise the most efficient way to visit all given locations in the shortest time - students will connect knowledge from history and art history and apply them to specific tasks of determining the artistic style or period for individual buildings - students will name Zagreb's main squares, museums, statues, religious buildings and other landmarks, place them in a historical period and explain why, highlight important, useful and current facts - students will use digital technology to better navigate around the city and to research facts about some buildings, people or events

	- students will use digital tools to create a presentation and/or short video. - students will cooperate responsibly in a team - students will improve their communication skills in English
Digital tools:	mobile phones, Prezi, Google Slides, Premiere (video maker)
Number of students:	16-20 students
Duration of activities:	3 hours (180 minutes)
Evaluation of activities:	The next day, the students in the same group should make a presentation or a video project in which they should present their city adventure and prove that they completed all the tasks and had a lot of fun at the same time.
Examples of student's work:	https://drive.google.com/file/d/1xkxsGUxGEE6wkfCGuzIQ_vZrz80a6B1i/view?usp=sharing https://padlet.com/winklerica/nwtn3tdaswb1
Advantages of activities:	student connection within a group, developing problem-solving skills, creativity, digital and social competence, orientation, fun
Link on materials:	https://edutorij.e-skole.hr/share/page/document-details?nodeRef=workspace://SpacesStore/d1e2e2c1-075a-4b02-a6a3-059291fec7de

Group 2

1. King Tomislav Square
   A monument dedicated to Tomislav, Croatia's first king, dominates the square carrying his name. This courageous warrior defended the continental part of Croatia form Hungarian attacks and for the first time united all Croatian lands into one country. Tomislav successfully sought papal recognition of his realm, and was crowned as king in the year 925.
   The statue of Tomislav on horseback was completed by sculptor Roben Frangeš Mihanović in 1938, but because of WWII the statue is installed in its current location 1947.
   Take a photo!

2. The Manduševac Fountain
   The Manduševac Fountain is situated on the main square, Square Ban Josip Jelačić, was built above a natural spring that provided Zagreb with drinking water right up until the end of the 19th century. Court records about the persecution of witches mention the spring as their main meeting point. There is also a legend connecting the spring with the name of the city. Namely, one sunny day an old Croatian war leader was returning from battle tired and thirsty, and asked beautiful girl Manda to scoop up some water from the spring for him. The Croatian word for „to scoop the water" is „zagrabiti". So the spring got the name Manduševac, after the girl, and the town got the name Zagreb, after the scoop of water.
   Task: throw a coin into the fountain.

3. Tkalčićeva
   Undoubtedly Zagreb's most colourful downtown street, Tkalčićeva (commonly known as „Tkalča") is built along the course of the former Medveščak creek, traditionally boundary between the settlements of Kaptol and Gradec. Everything to the east of the creek belonged to church-controlled Kaptol, while the west side belonged to the secular Gradec. Most of Zagreb's watermills were concentrated around the creek, and in the 18th century ti became the site of workshops producing cloth, soap, paper and liqueurs. The creek was paved over at the end of 19th century, creating a street that quickly became the animated centre of commercial activity and nightlife. Today people of all ages come to Tkalča for its small boutiques, traditional shops, restaurants and cafes.
   Task: take a photo with statue of Marija Jurić Zagorka, the first female professional journalist in Croatia.

4. The Bloody Bridge
   This alley connecting Tkalčićeva with Radićeva is called „Bloody Bridge"because it was the location of a bridge that connected Gradec and Kaptol and a spot perfectly set for their frequent squabbles.
   Take a photo!

5. The Stone Gate
   One enters the Upper Town through the Stone Gate (Kamenita vrata), the only old town gate that has remained intact. Built in the Middle Ages, it assumed its final form after being rebuilt in the 18th century. Under the arch of the gateway is a chapel dedicated to the Virgin Mary. It holds a painting of the Virgin that was miraculously saved from a devastating fire in the year 1731, and the chapel has been a place of pilgrimage ever since. The Virgin Mary is the patron saint of Zagreb.
   Kamenita ulica (Stone Street) is the site of the oldest pharmacy in Zagreb, founded in the year 1355. The pharmacy is still very much in business.
   If you want, light the candle.

6. St Mark's Church
   St Mark's Square (Trg Svetog Marka) constitutes the heart of Upper Town, having formerly served and the main market square of the settlement of Gradec. Dominating the square is the 13th century church of St. Mark, a three-aisled Romanesque church which still retains much of its original shape. The Gothic arched ceiling and the sanctuary were added in the late 14th century, along with the fifteen statues that stands in niches above the southern portal. The church was substantially rebuilt in the Neo-Gothic style by Herman Bolle at the end of the 19th century.
   Governor's palace (Banski dvori) and Parliament also at St Mark's Square.
   Take a photo!

7. Funicular (Uspinjača!)
   The 66-metre-long funicular that connect the Upper and Lower Town is the shortest passenger cable railway in the world. The height difference between top and bottom is 30.5 meters and funicular takes 55 seconds to make the journey. Opened for passengers in 1890. When it was powered by steam, the funicular was the first ever means of public transport to be used in Zagreb, pre-dating horse-drawn trams by a whole year.
   Take a ride on a funicular to Ilica.

8. Petar Preradović Square („Flower Square")
   Petar Preradović Square was named after an army general and patriotic poet. His statue stands in the middle of the square and is popular meeting point. The square is colloquially known as „Flower Square" (Cvjetni trg), after the flower stalls which have been a feature of the place ever since the 14th century when fairs were here. On the northern side of the square is the Orthodox Church of the Holy Transfiguration, built at the end of the 19th century. Here you can get a true sense of Zagreb's outdoor lounge culture. For the locals, coffee is the ideal accompaniment to a serious business meeting or a good long gossip with a group of friends.
   If you have time, have a cup of coffee or tea.

9. Miškec's Passage
   The passage thet connects Masarykova with Varšavska is named after Miškec, a much-loved local character who occupies an important position in urban folklore. Born Mihail Erdec, Miškec was a well-known pre-World War II acrobat who was forced by injury into early retirement and a life on street.
   Take a photo!

10. Marulić Square and The Croatian State Archives
    Marulić Square is dominated by the former National and University Library, today home to the Croatian State Archives, Designed by architect Rudolf Lubynski in 1913. The building is by far the most beautiful example of Croatian Art Nouveau.
    Marko Marulić – writer and humanist, „father of Croatian literature" (1450.-1524.)
    Take a photo!

11. The Museum of Arts and Crafts
    Occupying the west side of Marshal Tito Square is the Museum od Arts and Crafts, founded in 1880. And one of the first institutions of its kind in Europe. The permanent exhibitions at the museum covers three floors and presents the development of applied arts from the Gothic period right through to Art-Deco. Just across the street is statue of St. George killing the dragon. Symbolizing the struggle between good and evil and the victory of Christianity over paganism.

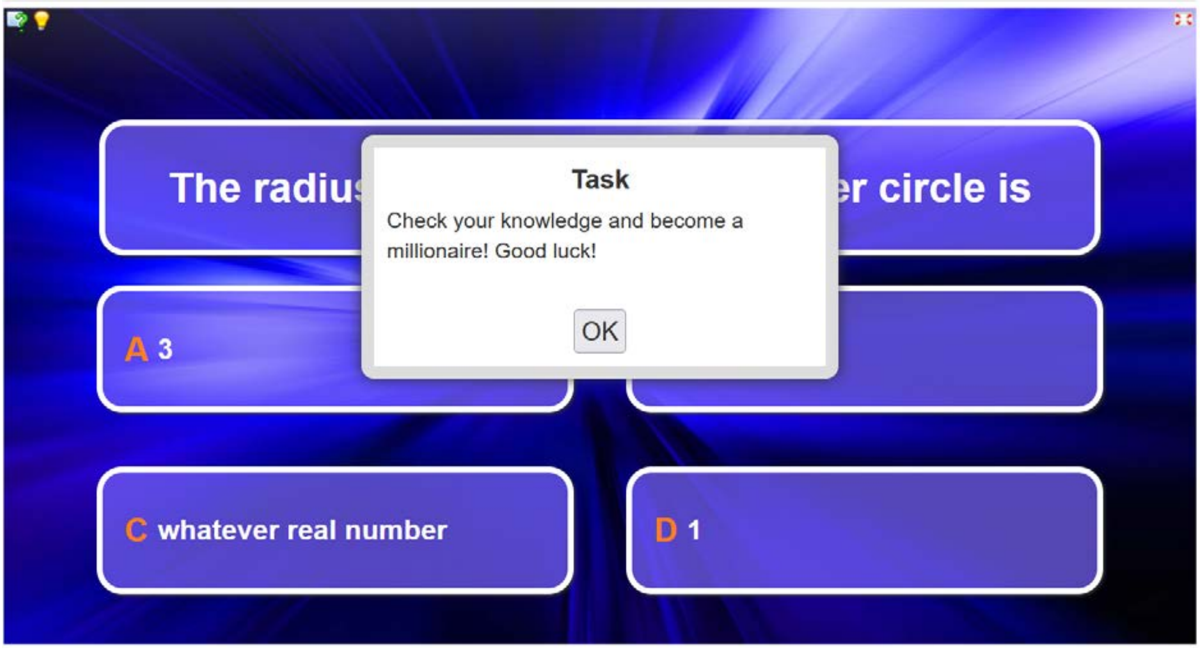
12. Zagreb University
    Running along the north side of Marshal Tito Square (opposite the Croatian National Theatre) is the main administrative building of Zagreb University. Founded in 1669. It is the oldest university in Croatia. It currently consist of 29 faculties, three academies and one university centre.
    In front of the entrance is Ivan Meštrović's „History of the Croats" a seated figure of a woman which eloquently symbolizes the calm strength of the nation.
    Take a photo!

The game "Who Wants to Be a Millionaire?" - Trigonometry

The game "Who Wants to Be a Millionaire?" is known as an entertaining and educational TV show. As such, it is also very useful in classes where we can use it to repeat learned content. The game starts with simple questions that, if answered correctly, win small sums of money. As the contestant advances on the scale, i.e. answers more and more complex questions, the monetary value for these answers increases. If the contestant manages to answer all the questions correctly, he wins one million monetary units. Instead of monetary units, students can be evaluated in a pre-arranged way. Considering the large number of students in the class, students can be divided into groups of four students each, and compete with each other.

Authors:	Ivana Imbrija
Subjects:	Mathematics, Informatics
Description of activities:	Using the Millionaire game, the students will repeat the learned content in mathematics. The students will be divided into groups of four students and each of them will try to solve 6 questions of different difficulty and thus become a millionaire. If the student does not know the correct answer, it is the next student's turn starting from the beginning. Students in groups can play three rounds. The best placed students from each group will then compete against each other by playing the game in two rounds. The sum of the numerical amounts won is seen in the final standings. The three students with the most money won will be evaluated with a grade. Also, if someone reaches millions in the group competition, he no longer plays and is considered the absolute winner.
Outcomes:	- students will define a trigonometric circle - students will define the relationship between radians and degrees - students will relate angles in radians to those in degrees, and vice versa - students will define the principal measure of an angle - students will practice determining the main measure of an angle - students will determine the fundamental period of trigonometric functions on simple and complex examples - students will repeat the definition of even and odd trigonometric functions - students will be able to determine the parity of a function by applying the properties - students will determine the value of the function for a certain angle by reducing it to the first quadrant - students will determine the quadrant in which a certain angle is located - students will be able to determine the values of other trigonometric functions using the value of one trigonometric function - students will be able to calculate the values of complex trigonometric expressions - students will cooperate responsibly in the group
Digital tools:	mobile phones, learningapps
Number of	6 groups of 4 students

students:	
Duration of activities:	2 x 45 min
Evaluation of activities:	evaluation of students with the best results
Advantages of activities:	student connection within a group; a different way of revising teaching content
Link on materials:	https://learningapps.org/watch?v=peyshsy1a20

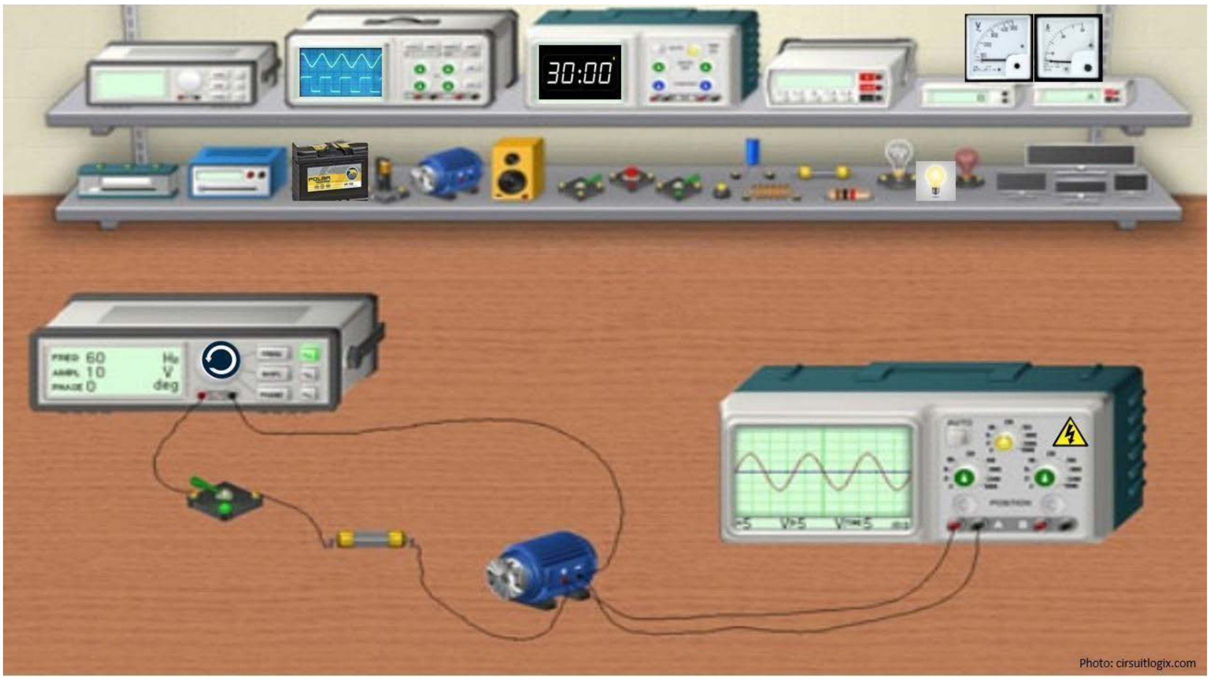


Fundamentals of Electrical Engineering - Digital Escape Room

The game is designed to develop the skill of logical thinking. It consists of different puzzles that need to be solved in order to unlock the door and exit the room. Riddles that were used in making this escape room were puzzles, crossword, game Hangman, quiz, rebus and mathematical/electrical engineering tasks. All of them contain questions from different parts of the subject Fundamentals of Electrical Engineering and some of them are interdisciplinary connected with Mathematics.

Author:	Sunčica Tokić
Subjects:	Fundamental of Electrical Engineering, Mathematics, Informatics, English language
Description of activities:	Instead of classical exercise by answering questions and solving problems on board, students were solving riddles to collect keys to leave the room. This activity develops logical thinking, skills of connecting different parts of educational curriculum and teamwork. Students are divided in pairs and given short instructions. Detailed instructions and background story of the escape room are in the materials. After reading them, students start the timer in the room, and they have 30 minutes to solve all the riddles. In the escape room they will find an electrical laboratory with hidden clues in it. They have to find it and click on it to open the riddle. Answers (keys) to riddles must be written on paper and after solving all riddles students will try to unlock the digital door by clicking on the keyhole. A Google form will open which they have to fill out and send the answers. If they are all correct, they will successfully unlock the door. Pairs compete and the fastest that sends all the correct answers will win. For their work students will be evaluated.
Outcomes:	Students will: - Solve the given riddles - Connect mathematical knowledge with knowledge in Fundamentals of Electrical Engineering to solve tasks with calculation - Determine basic terms in Fundamentals of Electrical Engineering (circuit, network, voltage, resistance, current…) - Determine basic concept of Fundamentals of Electrical Engineering (electrical network, different connections in electrical networks, relationships between current, voltage and resistance, use of source…) - Name basic terms and connect them to get structures in Electrical Engineering - Use digital tool to show their result after solving all riddles - Communicate and cooperate with their partner - Improve their social and communication skills - Improve their digital skills and competence - Improve their English skills in professional area
Digital tools:	Computers, PowerPoint, Google presentation, online Hangman, online Crossword, Google documents, FlexiQuiz, online Puzzle, Youtube, Google form
Number of students:	6 groups of 2
Duration of activities:	45 min
Evaluation of activities:	Students will fill out the Google forms with answers and will be evaluated.

Advantages of activities:	Different ways of solving tasks, repetition of curriculum and establishing facts in the subject's curriculum. Developing skills of logical thinking and teamwork, digital competence. Having fun while learning.
Link on materials:	https://edutorij.e-skole.hr/share/page/document-details?nodeRef=workspace://SpacesStore/f2d961f5-9542-4938-a983-59ecb0d34ac5



eTwinning project: European Escape Room

Authors:	Jasna Dobrotić, Anica Fintić, Iva Rožić
Subjects:	Informatics, Geography, Biology, English language
Description of activities:	Escape room tasks to get to know Croatia. Students try to reach the end of the escape room activity through a series of connected rooms. During the transition from room to room, students study the educational materials that each room contains and, based on what they have read, try to answer questions and find the password to move to the next room. The theme of each of the three escape rooms is a certain part of Croatian heritage (culture, geography, sights of certain regions...).

Outcomes:	- the student analyzes a longer adapted or original text while listening and reading. - discusses information about various Croatian landmarks, regions and heritage. - recognizes and uses complex cognitive, metacognitive and socio-affective language learning strategies. - independently and self-initiatively searches for new information from various sources, transforms it into new knowledge and successfully applies it when solving problems. - communicates well with others, cooperates successfully in different situations and is ready to ask for and offer help. - independently critically evaluates the process, sources and search results, selects the necessary information.
Digital tools:	Genial.ly, Canva, YouTube, Kahoot
Number of students:	Students work in pairs or small groups of up to 4 students. In total, one class (approximately 24 students) participates in the activity.
Duration of activities:	30 – 45 minutes
Evaluation of activities:	The evaluation of the activity is carried out by the percentage of success in exiting the escape room activity. The fastest pair/group is the winner.

Advantages of activities:	
Link on materials:	bit.ly/escaperoomhr

TaleBlazer – Augmented Reality for presenting the tourist attractions

Durign the time of the pandemic, hotel and tourism education students from High School Ban Josip Jelačić in Zaprešić, had to come up with new ways of presenting the tourist attractions of our city.
Students were using TaleBlazer application. TaleBlazer is the augmented reality (AR) software platform. By situating games in the real world, AR games seek to engage people in experiences that combine real landscapes and other aspects of the physical environment with additional digital information supplied to them by smartphones.

The game is interactive and can be connected to Google Maps, and the questions are triggered when the tourist approaches the given attraction. The playar is moving around the location following instruction and map on application. Who manage to visit all location and answer the question correctly in the shortest period of time – wins!

Author:	Helga Kraljik, Željka Brezni, Sanja Jelaković-Kuhner
Subjects:	Cultural Heritage, Tourism, English, German, Italian, History, Geography, Informatics
Description of activities:	1. study of the history of Novi dvori 2. finding interesting things related to the attractions of Novi dvori 3. preparation of questions accompanied by own photos. The game was made in English, German and Italian as part of the work of the Multilingualism Promotion Section in High School Ban Josip Jelačić in Zaprešić, Croatia. 4. creating a game in the TaleBlazer application: the game is interactive and can be connected to Google Maps, and the questions are triggered when the tourist approaches the given attraction. 5. Field teaching: playing a game in New Courts (Zaprešić) and peer assessment - two things I liked and 1 that could have been better.
Outcomes:	Students will: - Create a digital game using real location and informatin to present tourist attractions in interactive way - Improve their English, German and Italian comunication skills in professional area
Digital tools:	Computers, TaleBlazer app, mobile phones
Number of students:	4 groups of 5 students
Duration of activities:	2 weeks
Evaluation of activities:	Peer assessment - two things I liked and two things that could have been better. Summative assessment using criteria: relevant information about the location, usage of language and technical aspects of game.
Advantages of activities:	Development of creativitiy and digital competencies. More interesting way to present a tourist destination.
Link on materials:	English: gsijwkz German: gouwouv Italian: ghieihg https://sites.google.com/view/visejezicnostussbjj/zapre%C5%A1i%C4%87-as-a-tourist-destination/taleblazer-activities

8.3. GERMANY.

A practical use of digital games in the classroom requires a curricular connection, especially during the regular lesson time with regard to the shortening of the school time and the central examinations.
Binding orientations on the expected learning outcomes and regular reviews of the extent to which these are achieved are laid down in the core curricula. They describe the expected learning outcomes in the form of subject-related skills that are assigned to areas of competence based on subject didactics. This means that specific technical content and times are explicitly mentioned by which the students must have acquired the relevant skills.
It is therefore advisable to review the core curricula to determine the extent to which gamification can be integrated into regular lessons.

Since the consideration of all STEM subjects of all grades would go beyond the scope of this work, the subject curriculum mathematics of grades 5, 7I and 9I for the Bavarian Realschule is analyzed below as an example.

Presentation of various digital games and learning platforms for use in mathematics lessons

The Anton- APP

The ANTON APP is presented here as an example of playful learning support. Anton is an EU-funded interactive learning app for students in grades 1-10. Class. It contains a wide variety of curriculum-oriented exercises for the respective subjects, which are sorted into grades. The subjects currently offered are mathematics, German, general studies, music and DaZ (=German as a Foreign Language). The use of the app is and will remain free of charge. After registering as a teacher, you can set up a class and print a list of registration codes for the students. The progress of the children can be viewed by the teacher. From the student's perspective, the incentive to carry out the exercises is certainly the purchase of so-called "coins" after each successfully completed exercise, with which they can then "pay" for playing time.
The existing games also partly train the motor or tactical skills of the students, so that a general increase in learning is also achieved here.[1]

GeoGebra

GeoGebra is dynamic mathematics software that offers a variety of uses for students and teachers. The software dynamically combines geometry, algebra and tables. GeoGebra has different views that provide the ability to view mathematical objects from both a graphical and an algebraic perspective. The different representations of the objects are dynamically connected to each other. This not only allows you to draw geometric objects, but also to change them by entering and manipulating the equations.
For example, such a manipulation or display change can take place in the table view, in the graphics view or by the computer algebra system (CAS). In class, GeoGebra can be used, for

[1] Manuel Stenzhorn, Anton; 2021; https://digitale-schule.net/apps/anton#:~:text=Ant

example, as an interactive whiteboard or as an interactive worksheet for independent practice. The interactivity of the software can be increased through the use of sliders, checkboxes and perspective changes. Furthermore, GeoGebra has a large material pool and an exam mode.[2]

Photomath

One of the most innovative apps that has hit the market in recent years is called Photomath. Here, users can have mathematical tasks solved by taking pictures with their mobile phone camera and the correct result is determined within a few seconds. In addition, the solution paths are also displayed. So, this app is both a curse and a blessing. On the one hand, cheating has never been made so easy for students, on the other hand, they learn something by displaying the solution steps.[3] In this way, they can better understand how the task can be solved without a cell phone camera. The basic arithmetic operations are currently supported, especially when solving simple equations. The app recognizes decimals, fractions, roots and powers. The amazing thing is that Photomath not only captures computer writing, but also handwriting. Linear equations can be solved without any problems, but complicated integral and differential equations from the upper level cannot yet be solved. These currently overwhelm the app.[4] The real added value is that instead of wasting a lot of time on headaches, the students spend more time solving tasks. The playful approach makes it easier to find access to mathematics instead of constantly despairing. Photomath aims to increase both the understanding and the confidence of today's students.[5]

Minecraft

Minecraft is a computer game in which players can build and dismantle their own three-dimensional world and recombine materials. You have blocks, materials and tools at your disposal to do this. Depending on the setting, Minecraft can be played in survival mode with life points and hunger or in creative mode with unlimited resources and a flight mode. The player decides for himself which setting he prefers. Due to the player's ability to actively redesign the game world, Minecraft falls under the category of open-world and sandbox games. Nevertheless, Minecraft has been used in schools for several years, and the trend is increasing. The application examples extend across different subjects and grades and offer a large number of methodological variants. Self-made machinimas in German, dealing with proportionality through the reconstruction of the school building in mathematics, role-playing games on trade relations in politics and economy, atomic construction models in chemistry and programmable, virtual turtles in computer science are examples of possible areas of application in the educational context. The list cannot be fully recorded because, unlike other digital service tools, Minecraft spreads largely unnoticed in the school context. With Minecraft Edu from the Finnish company "Teacher Gaming LLC", which has already sold the game to Microsoft, an easy-to-administrate version of the game especially for schools is now available in addition to the classic versions.[6]

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[2] https://cms.sachsen.schule/lademo/computergrafik/geogebra.html; 20.06.2022

[3] https://www.sn.at/panorama/medien/diese-app-ist-der-feind-aller-mathe-lehrer-3026554; 29.06.2022

[4] https://www.stern.de/digital/smartphones/photomath--diese-smartphone-app-loest-mathe-aufgaben-mit-der-kamera-3836140.html; 29.06.2022

[5] https://photomath.com/de/parents; 29.06.2022

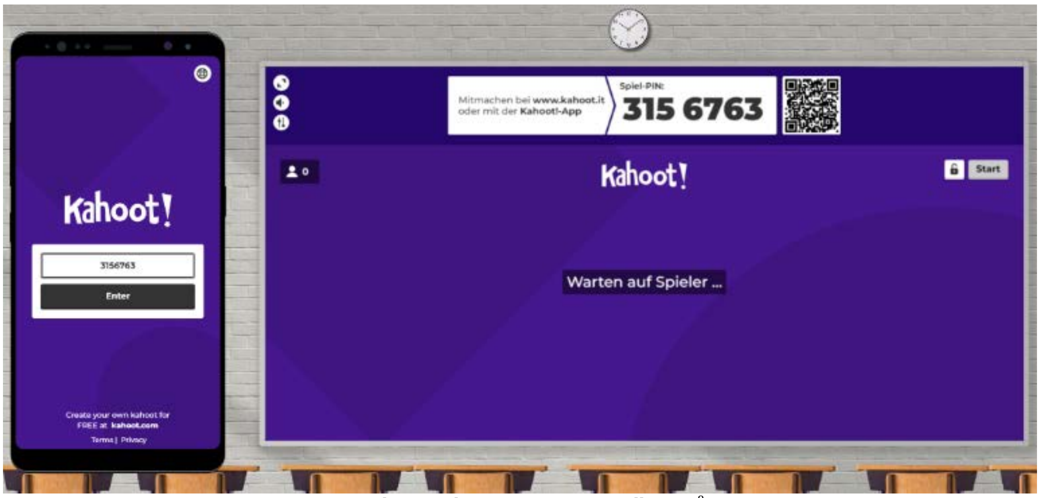
[6] TYPO3- Themes Team; 2022; https://www.friedrich-verlag.de/bildung-plus/digitale-schule/medieneinsatz-im-unterricht/spielerisch-lernen/minecraft-als-lernumgebung/

LearningApps

LearningApps is a free, web-based authoring software and platform that is intended to support learning and teaching through small interactive modules, multimedia learning modules, the so-called apps. Users can integrate existing modules directly into learning content, but they can also create or change them online themselves. The aim is to collect reusable building blocks and make them publicly available. Formats such as multiple choice, assignment exercises or fill-in-the-blank tests are available. The apps can be shared with learners via a web link or QR code or embedded directly in a learning platform via HTML code.

Kahoot

Kahoot is a learning platform designed to enable students to learn through play. It offers the possibility to integrate interactive media into the lesson. The teacher can either create different games themselves or select a game that suits them from the already large collection of games. It is up to the teacher to decide whether the work they produce should be available to the public or not. The aim of each quiz is to query the level of knowledge of the students on a specific topic and also to get an evaluation directly. The fact that the learners compete against their classmates alone or in a team creates enormous motivation to answer the questions correctly.[7]



Graphics: Kahoot Design vor Spielbeginn[8]

Curriculum-related embedding of gamification in mathematics lessons

In the following, the Bavarian Realschule curriculum for the subject of mathematics is presented and various options are presented, to what extent the in the first point digital games and learning platforms presented can be integrated.

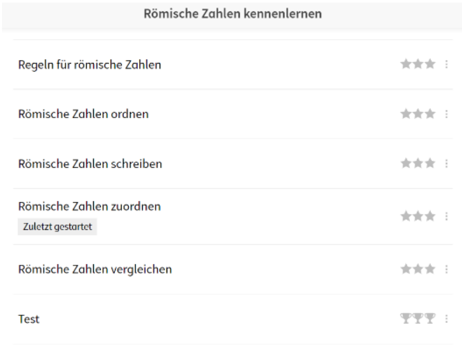
class 5

- Learning area 1: natural numbers
- Learning area 2: whole numbers
- Learning area 3: basic geometric ideas and concepts

[7] TYPO3- Themes Team; 2022; https://cms.sachsen.schule/lademo/interaktive-medien/kahoot/
[8] Anita Sommer, 2022; https://create.kahoot.it/preview/30ebe70d-0eae-48d2-95a7-638480892b50

- Learning area 4: sizes
- Learning area 5: perimeter and area of plane figures
- Learning area 6: evaluation of data[9]

For example, the ANTON app could be installed here in learning area 1 to deepen the topic of number systems.



Graphics: Anton, exercises on Roman numerals[10]

Graphics: Anton, Match Roman numerals [11]

The graphic on the left shows various exercises that are offered for the Roman numerals. The exercise "Assigning Roman numerals" is shown on the right as an example. The unit increases its difficulty with each exercise. At the end of each learning block, the learning progress can be determined by a test.

In learning area 2, a quiz from the Kahoot learning platform can be used to ensure learning. The students should arrange whole numbers here (see graphic). The answers are put in the right order by moving the squares. Immediately after voting, the resolution and then the team's score is displayed. The quicker the correct answer is entered, the more points the player or team gets.

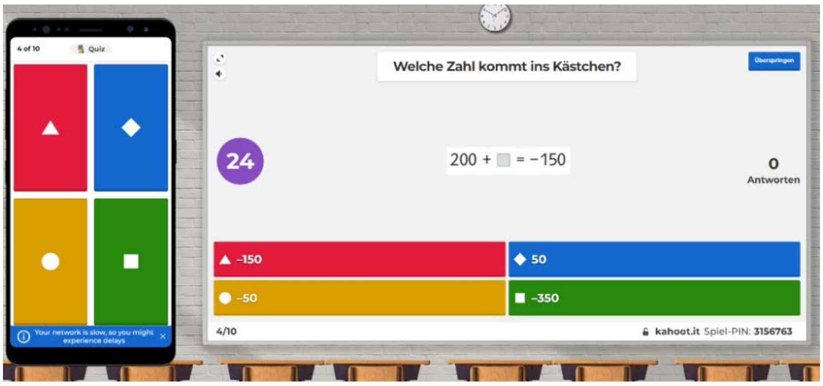
[9] https://www.lehrplanplus.bayern.de/fachlehrplan/realschule/5/mathematik; 20.06.2022

[10] https://anton.app/de/lernen/mathematik-5-klasse/thema-01-natuerliche-und-ganze-zahlen/uebungen-11-roemische-zahlen-kennenlernen/; 20.06.2022

[11] https://anton.app/de/lernen/mathematik-5-klasse/thema-01-natuerliche-und-ganze-zahlen/uebungen-11-roemische-zahlen-kennenlernen/uebung-05/; 20.06.2022

Graphics: Kahoot about „Ordering whole numbers“ [12]

Another example of the playful control of learning content in the area of arithmetic with whole numbers can be seen in the next graphic. The gaps must be filled correctly depending on the invoice. All types of calculation, addition, subtraction, multiplication and division are linked with each other.



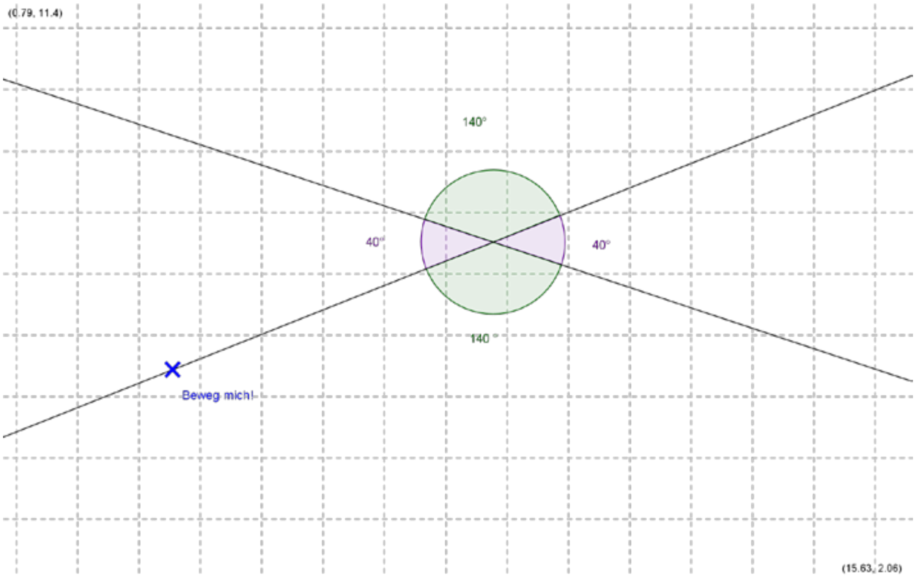
Graphics: Kahoot about„Calculate with whole numbers“ [13]

To convey the basic geometric ideas and concepts (learning area 3), it makes sense to integrate the geometry software GeoGebra.

For example, points, stretches, straight lines, semi-straight lines, circular lines, circular areas or sectors of a circle can be digitally drawn by the students with simple means and their properties (length of a stretch, distance, distance, radius and diameter of the circle) can be examined.

In the coordinate system, geometric figures (triangles, squares, etc.) can be represented very easily and their characteristic properties can be filtered out. In the graphic below, a specially created GeoGebra file on the subject of side and vertical angles is presented. The blue dot labeled "Move me!" allows you to change the crossing of the lines and thus also the size of the angles. It is very easy to research to what extent the opposing and adjacent angles are related in terms of their magnitudes.

[12] https://create.kahoot.it/preview/45c298c1-f95c-4f5f-889d-c86e7ed75f0d; 20.06.2022
[13] https://create.kahoot.it/preview/30ebe70d-0eae-48d2-95a7-638480892b50; 20.06.2022



Graphics: GeoGebra Datei for playfully discovering side and vertical angles

Dealing with the scale in learning area 4 is very often difficult for most students. With the computer game Minecraft, this challenge can become an unforgettable experience. In small groups, the learners can measure their own school building and build it in Minecraft to a suitable scale.

Graphics: Minecraft, digital replica of a school building[14]

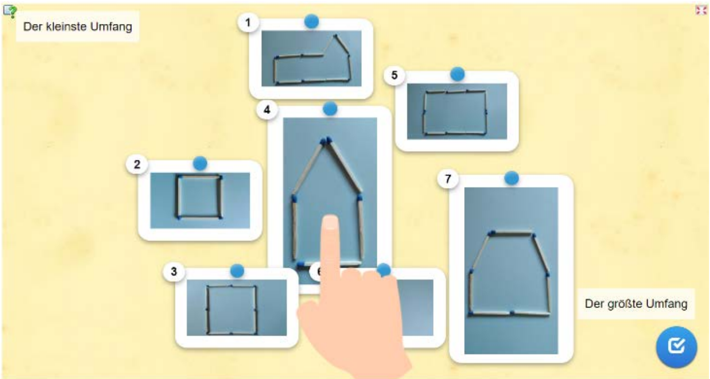
Thus, they not only deepen the units of length, but also solve everyday problems using suitable strategies and through mathematical modelling. The students themselves determine a reasonable scale for the reduction, calculate lengths using the scale and then carry out the digital reproduction true to scale.

This example of self-experienced, applied and digital mathematics leads to an increase in motivation and perseverance. The joint true-to-scale reconstruction of a building not only requires intensive collaboration, but also a high degree of communication skills, the ability to make compromises and to cope with setbacks.[15]

[14]Tilo Bödigheimer; Spielerisches Lernen mit Minecraft; https://www.friedrich-verlag.de/bildung-plus/digitale-schule/medieneinsatz-im-unterricht/spielerisch-lernen/spielerisches-lernen-mit-minecraft/; 20.06.2022

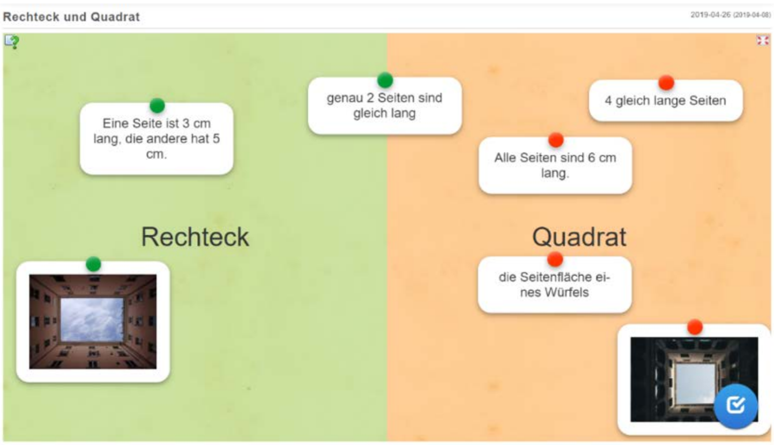
[15] Tilo Bödigheimer; Spielerisches Lernen mit Minecraft; https://www.friedrich-verlag.de/bildung-plus/digitale-schule/medieneinsatz-im-unterricht/spielerisch-lernen/spielerisches-lernen-mit-minecraft/; 20.06.2022

As an example, for the use of the playful learning platform LearningApps, the treatment of the topic perimeter and area of rectangle and square is mentioned here. For example, as shown in the graphic below, LearningApps can be used to playfully grasp the concept of scope. The typical student error of confusing perimeter and area can thus possibly be avoided by making the perimeter more tangible. In this app, with the help of matchsticks of the same size, the scope is to be sorted by size. The more matches needed for the figure, the larger the girth.



Graphics: LearningApps; Understanding the concept of scope[16]

The graphic below shows another example of the learning platform. The perimeter of a rectangle and a square are compared. The statements shown fit either one of the two geometric figures or both. They must therefore be assigned to the rectangle or square and then checked by pressing the blue button.



Graphics: LearningApps; A comparison of the perimeter of a rectangle and a square[17]

class 7

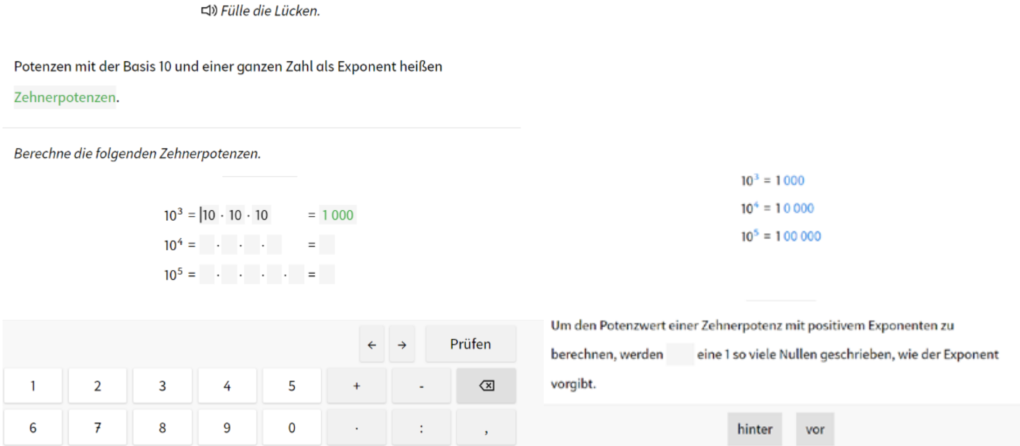
According to the Bavarian curriculum, grade 7I (maths class) deals with the following topics:

- learning area 1: potencies
- learning area 2: parallel displacement

[16] https://learningapps.org/11284836; 20.06.2022
[17] https://learningapps.org/7071056; 20.06.2022

- learning area 3: triangles
- learning area 4: spatial geometry
- learning area 5: geometric locus lines and locus areas
- learning area 6: terms, equations and inequalities
- learning area 7: proportionalities
- learning area 8: evaluation of data [18]

The powers of ten, which can be found in learning area 1 in the curriculum, can be worked out in a playful way with the ANTON app.



Graphics: Anton; exercises- Powers of Ten[19]

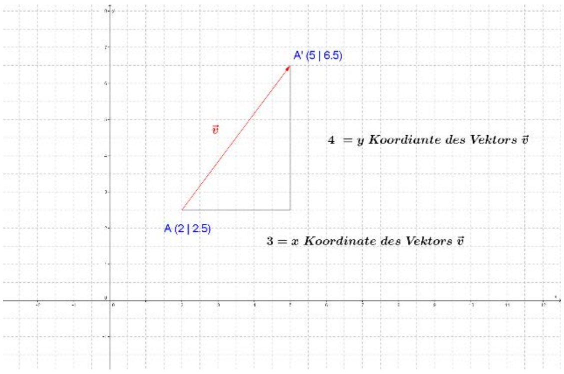
Through trial and error, the children explore the meaning of powers of ten and can use the exponent after just a few tasks.

The development of both geometric learning areas, parallel displacement as well as geometric locus lines and locus areas, can be very well supported in the classroom with the help of GeoGebra. By using student iPads or by using the computer room, the students can independently change points in the app, draw special straight lines and routes and thus work out and understand mathematical facts. Thus, through the independent development of subject areas, the motivation and memory of the students is increased.

The graphic below shows how the vector $\vec{v}$ and its given coordinates are changed by moving the points A and A`. The connection between the image and original point coordinates and the coordinates of the vector can thus be understood very easily.

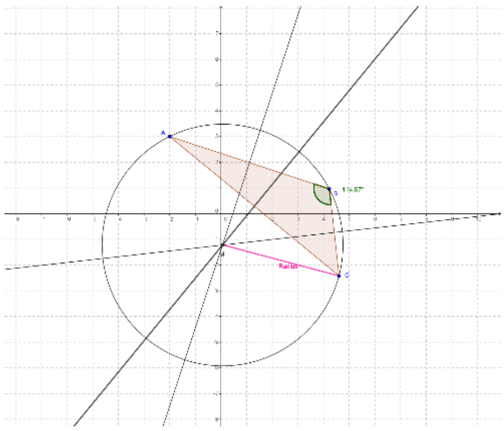
[18] https://www.lehrplanplus.bayern.de/fachlehrplan/realschule/7/mathematik/wpfg1; 20.06.2022

[19] https://anton.app/de/lernen/mathematik-9-10-klasse/thema-01-wurzeln-und-potenzen/uebungen-04-zehnerpotenzen/uebung-01/



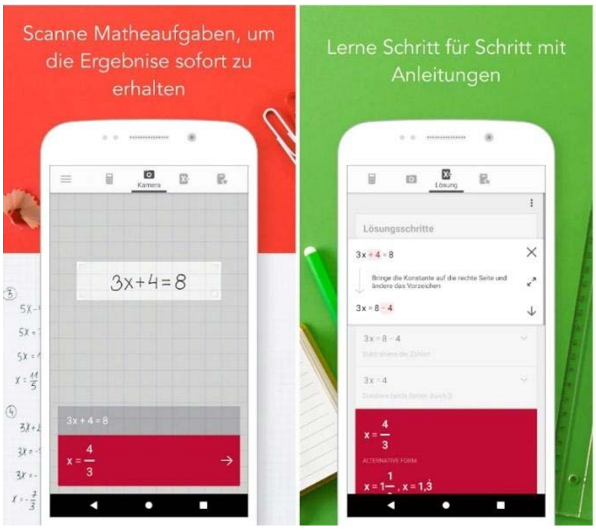
Graphics: GeoGebra; Examination of the vector coordinates

The second image shows the self-created interactive worksheet on the subject of constructing a perimeter and examining the position of the center of the perimeter in relation to the specified triangle. The vertices of the triangle can be moved. Depending on how the points are changed, the center of the circle is either inside or outside the triangle. There is therefore no need for a complex construction of each individual circle in order to examine the position of the center of the circle or of the Thales circle. The use of this app should not replace the ability of our students to construct geometric figures with compasses and rulers, but rather create motivation to work out more complex relationships.



Graphics: GeoGebra; Examination of the position of the circumcentre

With the Photomath app, it is possible to outsource the improvement of algebraic tasks in class or for homework for learning area 6 “Terms, equations and inequalities”. Tasks that are designed for the purely systematic solution of equations or inequalities can be solved by the students without much effort, with a quick scan, using the Photomath app and the solution steps can be understood. There is then more time in class to work out problem-solving strategies and analyze more complex tasks.



Graphics: Photomath; Scan of a linear equation including display of the solution steps[20]

Learning area 8, which deals with the topic of "evaluating data", is intended to help students to understand and critically question everyday graphics, diagrams or statements. At the end of the learning unit, the level of knowledge can be playfully checked with a Kahoot game.
Since there is already an enormous selection of games on Kahoot.com, the teacher does not even have to create a quiz himself, but can use the freely accessible question-and-answer tasks that have already been created. The graphic shows an example of a question on an available quiz on the subject of "data analysis".

Graphics: Kahoot; Evaluation of given diagrams[21]

class 9

Year 9 I (maths class)deals with the following topics:

- learning area 1: real numbers
- learning area 2: centric elongation

[20] Denny Fischer; 2019; „Photomath: Mit dieser Android-App löst du fotografierte Rechenaufgaben“;

https://www.smartdroid.de/photomath-mit-dieser-android-app-loest-du-fotografierte-rechenaufgaben/
[21] https://create.kahoot.it/details/4a4cda57-233a-4752-affd-87ba05db8ee9; 20.06.2022

- learning area 3: right triangles
- learning area 4: circle
- learning area 5: spatial geometry
- learning area 6: systems of linear equations
- learning area 7: quadratic functions and quadratic equations
- learning area 8: Data and coincidence [22]

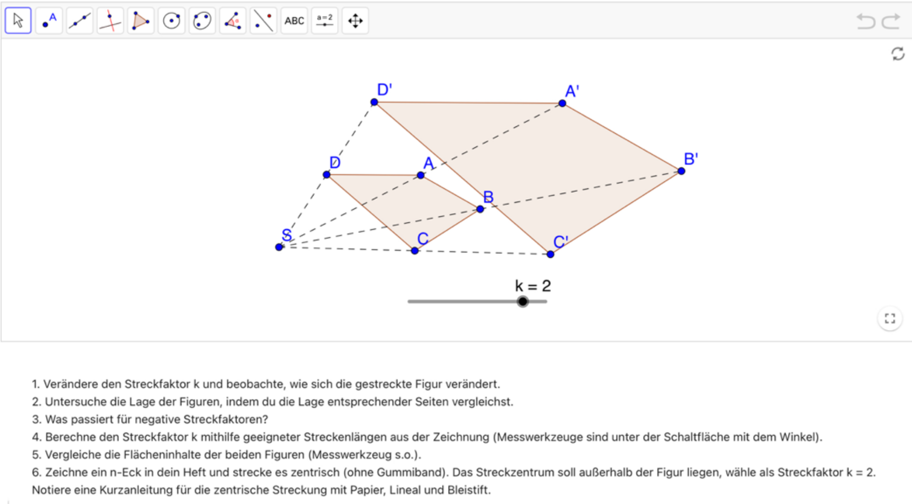
In learning area 1 of grade 9 I, the real numbers are to be worked on. The ANTON app can be very useful even for older students, as they can approach the square root by trying it out. This not only affects understanding how a square root is defined, but also arithmetic with roots.

Graphics: Anton; home- roots[23]

Graphics: Anton; Home- counting with roots[24]

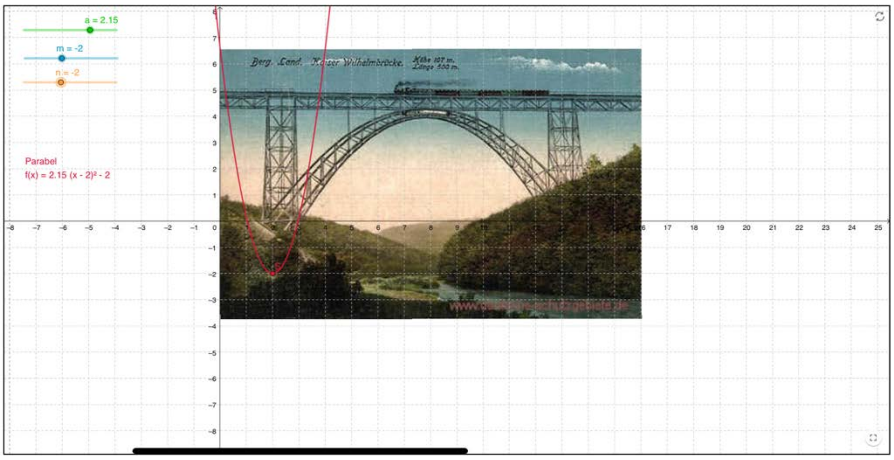
Even in the 9th grade, the geometric learning areas of right-angled triangles, circles, spatial geometry and quadratic functions can be illustrated very well with GeoGebra. By experimenting with various sliders (in the following Fig. with the stretching factor k), the students recognize the graphic effect a change has on the centrically stretched figure. Among other things, they understand independently when the image and original figure are on the same side or on different sides of the center of extension S. The properties of centric stretching can thus be developed and internalized in a playful way.

[22] https://www.lehrplanplus.bayern.de/fachlehrplan/realschule/9/mathematik/wpfg1; 29.06.2022
[23] https://anton.app/de/lernen/mathematik-9-10-klasse/thema-01-wurzeln-und-potenzen/uebungen-01-wurzeln/; 12.10.2022
[24] https://anton.app/de/lernen/mathematik-9-10-klasse/thema-01-wurzeln-und-potenzen/uebungen-02-mit-wurzeln-rechnen/; 12.10.2022



Graphics: GeoGebra; Elaboration of the properties of the centric extension[25]

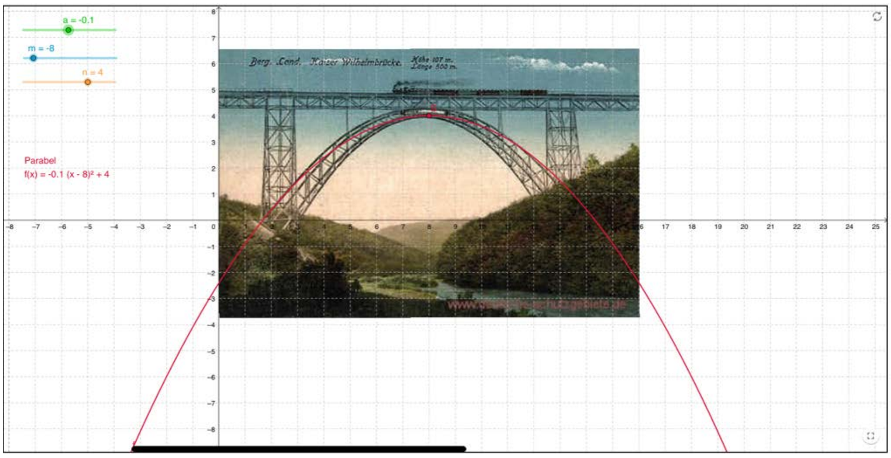
GeoGebra can also be used very well when drawing parabolas. A concrete application reference in practice is always important to the students in particular, so that they see a purpose behind school mathematics. Teachers are often put to the test with these questions and cannot find any suitable justifications. A link to the real world can be deliberately created here. The first image in the following Fig. shows the initial situation of a deliberately misplaced parabola, which is to be shifted by the sliders of the variables of a quadratic function in such a way that the parabola assumes the shape of Kaiser Wilhelm's Bridge as precisely as possible (see the Figure below). The resulting quadratic function is then transferred to the students' exercise books.



Graphics: GeoGebra; Kaiser Wilhelms Bridge; elaboration of the meaning of the variables a, b, c of a parabola; initial situation[26]

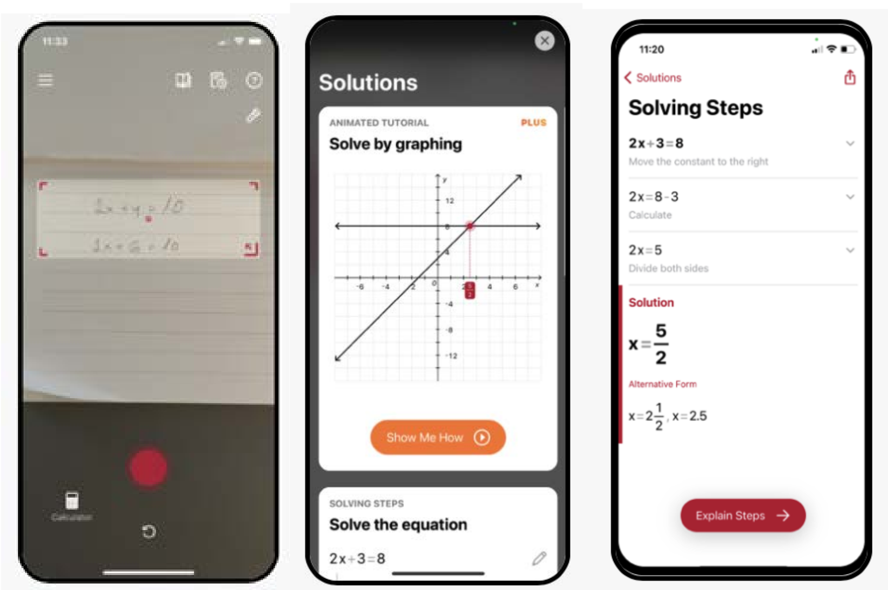
25 https://www.geogebra.org/m/fzBvpC8D; 26.07.2022

26 https://www.geogebra.org/m/jDnbaAAc#material/vAwmaURM; 26.07.2022



Graphics: GeoGebra; Kaiser Wilhelms Bridge; elaboration of the meaning of the variables a, b, c of a parabola; *final position*[27]

The Photomath app can again be used excellently in learning area 6 "Systems of linear equations" in order to be able to quickly check yourself for correctness at home or in practice phases of lessons at school. The students use the app to photograph a linear system of equations given in handwriting or computer writing. The amazing thing about this is that you can not only display the individual solution steps for solving a system of linear equations, but also the geometric meaning of the intersection of two straight lines is made comprehensible. This time saving has a positive effect in the classroom on working on more complex tasks and thus on increased problem-solving skills.

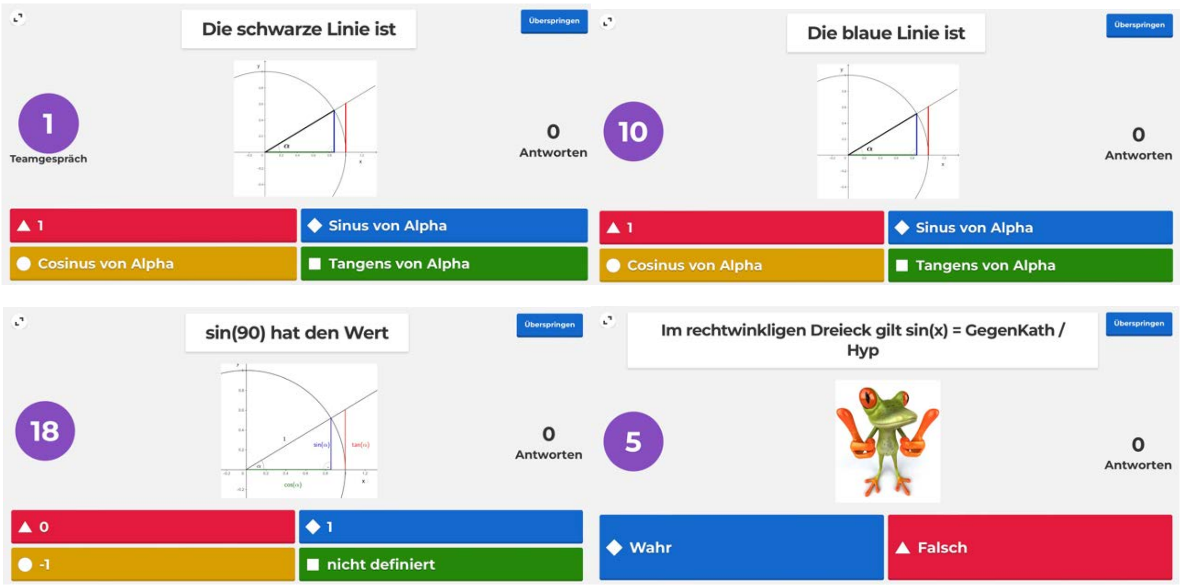


Graphics: Photomath, system of linear equations[28]

Learning Area 3, Right Triangles, can be deepened through the playful app Kahoot. It is useful, for example, after the introduction of the three trigonometric functions sine, cosine and tangent. The meaning of the graphic representation as well as the meaning of this on the unit circle should also be explained in advance.

[27] https://www.geogebra.org/m/jDnbaAAc#material/vAwmaURM; 26.07.2022

[28]https://photomath.com/de; 08.07.2022

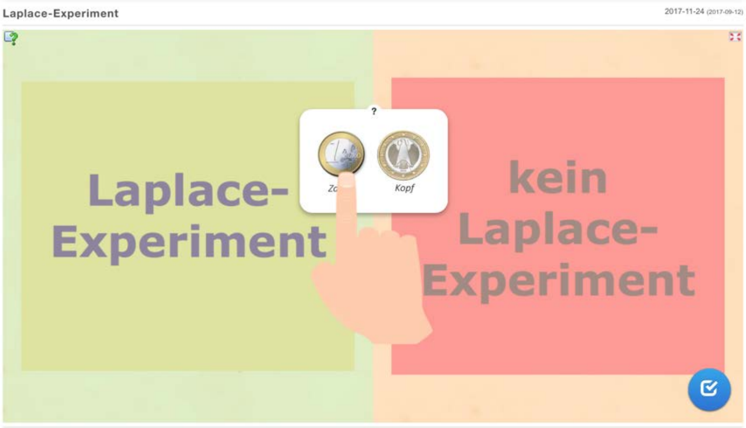


Graphics: kahoot, trigonometry[29]

The students not only have to know the three angle functions and their definitions, but also understand the graphic meaning of the unit circle in connection with the coordinate system. The Kahoot app is also relevant in higher grades, as it has a certain competitive character and the students are very motivated to answer the questions correctly. Furthermore, Kahoot can be used in the so-called team mode, so that social skills can also be trained here and teamwork can be expanded.

LearningApps is an example of playful handling of data and coincidence in the 9th grade. This gives the opportunity to check whether the students have understood what a Laplace experiment is. Most of the time, however, they find it difficult to understand what it means that every elementary result of a random experiment has the same probability in the concrete implementation or assignment. In the image below, you can see that a coin is tossed, so there is an equal chance that the number or heads will face up. Thus, this random experiment can be assigned to a Laplace experiment. The visual component gives checking the content a different depth compared to stupid verbal or even written queries.

[29]https://play.kahoot.it/v2/start?quizId=af2b89f4-f7e9-4da1-8c04-c49a7554bc7f; 26.07.2022



Graphics: LearningApps, Laplace-Experiment[30]

[30]https://learningapps.org/3810046; 26.07.2022

8.4. GREECE

Teaching Scenario:. Is the Earth flat? Flat Earthers". Problem Solving of fake news and STEM

It is shocking, but there are plenty of people around the world who genuinely believe the Earth is flat.Taken from the July 2020 issue of *Physics World*. Members of the Institute of Physics.

Educator/writer:	Flouri Eleni
Involved fields of knowledge.	Physics, Astronomy, Mathematics, Computing.
Duration of implementation:	3 - 4 teaching hours. There is space for enrichment with additional activities, if the group of students wishes do that.
Link to the Curriculum	The scenario is suitable for teaching in the General High School (grades A & B) and C grade of Gymnasium.
Class organisation:	The scenario is designed to take place in the school computer laboratory , where, there are the necessary digital resources to search for information. The school yard.
Goals and objectives:	**Cognitive objectives:** ✓ Solar system ✓ Historical facts about Eratosthenes and his experiment. ✓ To understand what the summer solstice is. ✓ Find the best time to carry out the experiment depending on their position on Earth. ✓ Use Google Earth to calculate the distance of their position from the equator. ✓ Create a program to calculate the radius of the Earth. ✓ To calculate the height of objects from 1) the shadow they create and 2) pictures of their mobile phones.

	Skill Objectives: ✓ using different materials, ✓ using different techniques, ✓ to present research results **Attitudes/Behaviors:** ✓ working in teams, ✓ collecting, evaluating and justifying observations. ✓ Dealing with fake news in a scientific way
Brief description:	1. Trigger of interest: Students will be asked to refute the hypothesis that the Earth is flat. 2. Conclusions. Internal evaluation and external - evaluation. 3. Worksheet 4. Extending the action.
Number of students:	15-20 students in groups of 4-5 people
Underlying learning theory	Application of the discovery/investigative learning model. According to this theory, the following phases are followed: ✓ Interest trigger ✓ Hypothesis formulation ✓ Experimentation ✓ Conclusions - Theory formulation ✓ Testing - Evaluation
Classroom organisation:	The scenario is designed to take place in the school computer lab , where the necessary digital tools for searching for information are available, and in the school yard. Students work in groups of 4-5 people using one computer per group and a set of tools blocks.
Worksheets:	There is a worksheet for each lesson. The worksheets guide the student in carrying out the activities as well as in understanding the concepts.
Digital tools:	Google Earth , YouTube. Programming Language .
Proposals for further activities:	It is proposed to enrich the scenario with artistic activities (STEAM): Design a poster and organise an event to disseminate the action to their classmates
Script evaluation:	By carrying out and completing the worksheets and actively involving students in suggestions for further activities.

First activity

1) You are looking for the scientific background of Eratosthenes (before Eratosthenes) who were the Pythagorean astronomers, mathematicians and philosophers of the 6th c. e.g.
…………………………………………………………………………………………

2) How we can prove that the Earth is round?
…………………………………………………………………………………………

3) What is summer solstice?
…………………………………………………………………………………………

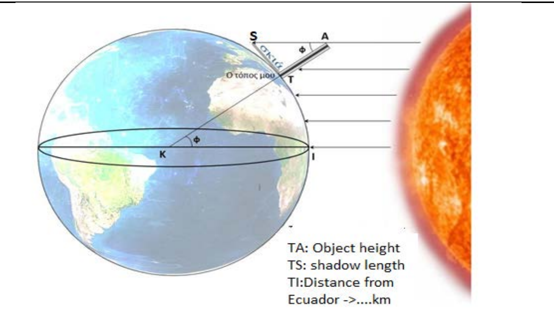
Second activity

Stargazing Basics | Observing & Learning the Night Sky

1) We point the telescope towards a certain planet or a certain star that we wish to observe. We notice that while initially, theobservation planet (eg Jupiter) is in the center of the eyepieceof the telescope, as time passes the planet moves through eyepiece ("runs inside the eyepiece"). Why does this phenomenon excists?
…………………………………………………………………………………………
2) Suggest "solutions" so we can always see the planet, in the center of the eyepiece.
……

Third activity

Experiment to measure the radius of the Earth

This is experiment is an example of practical geometry and an introduction into ancient cultures; the activity is not just STEM, but cross-curricular as well.	

Theory

If we consider that the circle in the above figure is the Earth then the ellipse in the center is the equator. We are doing the experiments on days near the vernal equinox (at those days on the Earth's equator will notice that the midday Sun is very close to the zenith).

Take a one-meter stick and place it vertically to the ground.

1) Measure the length of the stick TA Repeat the measurement five times and find

   TA=Ycm ….cm

2) . Measure the length of the stick's shadow Repeat the measurement 5 times and write the length.

   TΣ=Xcm.=……… cm

3) Appropriate time to take your measurement for each location is calculated from https://gml.noaa.gov/grad/solcalc

   ………………………………………………………………………………………

4) We calculate the tangent of the angle SAT from the X/Y ratio

   tanφ= X/Y = ………. Then φ= ………° (degrees)

5) Justify why the angle φ is equal to the central angle TKI

   ……………………………………………………………………….

Note: The angle φ is equal to the latitude only if the measurement is made on the days of the vernal or autumnal equinox

6) The distance from the equator TI=S calculated from the Google Earth

   S=…..Km

7) The perimeter of the Earth and its radius R are calculated using the following mathematical relations:

   Approx.Perimeter of Earth = (360/φ) * S = ………km

8) The radius of the Earth R is calculated from the relationship:

   R= Per Earth/(2*π)= …………km

Teaching Scenario: Flipped Classroom and STEM

There is research that confirms the positive impact that teaching using the flipped classroom has on subjects related to STEM education (Giannetsou, 2021). In addition to the benefits of implementing STEM education, the Flipped Classroom enhances learning outcomes as follows:

- Increases motivation for learning and active search for new knowledge
- Increases involvement in the learning process
- Strengthens students' autonomy and initiative, resulting in improved school performance.

Also, the Flipped Classroom offers multiple levels of interaction to participants. Students can work in groups or individually and use the social media they are very familiar with. Teachers can easily differentiate assignments to students (differentiated teaching) and make more efficient use of teaching time. For all the above reasons, the principles of STEM education and the Flipped Classroom were combined in this lesson scenario to enrich the teaching.

Teaching Scenario

«Kites in the sky»	
Teacher/author:	Angeliki Tenente
Fields of knowledge involved:	Science, Mathematics (Geometry), History, Art, Computer science, Literature
Duration of implementation	3-4 teaching hours. The script could be enriched with additional activities
Links to Analytical Study Program	The script is suitable for application in General Senior High School(B and C class). With appropriate adaptations, it can be applied to Junior High School and 5th and 6th Grade.
Aims and objectives:	Cognitive objectives: • understanding of basic physics concepts (gravity, force component, resistance), • understanding new concepts (Bernulli's law), • experimentally determine the flight conditions of the kite (flight angle, air movement, flight speed, etc.) • connecting laws of Physics with applications of daily life, customs and traditions of Greece and other peoples and cultures. Skill Objectives: • Use of different materials, • Development of argumentation skills and expression of opinion on scientific topics. • Cultivating skills of cooperation, teamwork, initiative and interpersonal communication. Attitudes/behaviors: • work in groups, • cultivating positive attitudes towards science and research. • Cultivating positive attitudes towards tradition and culture.
Summary:	1. Stimulate interest: with the help of Worksheet 1, students are asked to watch the video (https://www.youtube.com/watch?v=_74Nf4PFShk) about the construction of the kite and answer the questions by making the necessary internet research. They also look up the names

	of the kite in different countries through the WordArt.com app and get in touch with the cultural elements of the theme. This preparation is done before the group meeting (Inverted Classroom). 2. Formulation of research hypotheses. Kite design applying knowledge of geometry and design skills. Worksheet 2 3. Kite construction 4. Test flight. Conclusions. This – evaluation and the other – evaluation. 5. Search for information about the kite in art, history, literature, folklore (Greece and worldwide). Collection of literary texts related to the subject. Worksheet 3 6. Additional activities. Implementation of proposals if the group of students so wishes.

Underlying learnig theory:	Application of the discovery/exploratory learning model. According to this theory, the following phases are followed: • Interest trigger • Formulation of assumptions • Experimentation • Conclusions – Theory formulation • Control - Evaluation
Number of students:	15-20 students in groups of 4-5.
Class organization:	The scenario is designed to take place in the school laboratory, where there are comfortable workbenches and the necessary digital means to search for information. In the final phase of the experimentation, suitably selected outdoor spaces (without electric wires and trees) will be used. Students work in groups of 4-5 using one computer per group and a set of tools and building parts.
Work sheets:	There is a worksheet for each lesson. The worksheets guide the student in performing the activities as well as understanding the concepts.
Digital tools:	WordArt.com, YouTube.com
Suggestions for further activities:	It is suggested to enrich the scenario with artistic activities (STEAM): • Be inspired by their tradition or interests and decorate their kite accordingly • To organize a flying competition between the teams. • To design a poster and organize an event to spread the action to their classmates • To put on it Pressure Sensor, thermometer, moisture measuring device, to check the air.
Evaluation:	From the execution and completion of the worksheets and the active involvement of the students in the proposals for further activities

«Kites in the sky» (1)

The kite we fly on Clean Monday is one of the oldest customs in Greece. Its soaring and its dance in the wind, high in the deep blue sky, suggests the ascension, the purification of the soul after Carnival celebrations

How do they call the kite in different countries? (work in groups of 4)

Look at the cloud dictionary and search for the origin and meaning of the names.

Kite:……………………………………………………

Drachen:…………………………………………………

Tako: …………………………………….

Papalote:…………………………………………………

Φύσουνα(fisouna):……………………………………

Πετάκι (petaki)…………………………………………

How do I make a kite? (Work in group of 4)

Watch the video: https://www.youtube.com/watch?v=_74Nf4PFShk

Like an airplane, the kite flies because of its construction even though it is heavier than air. The traditional Greek kite has three parts:

1. The body, which consists of a light wooden frame covered with paper.
2. The tail, consisting of twine and paper strips
3. The control shaft, consisting of twine. The tail and control shaft help the kite pilot to control it.

Take notes on the materials and steps to make the kite.

«Kites in the sky» (2)

Archytas of Taranto (4th century BC) used the kite in his aerodynamics. There is a classical Greek vase depicting a daughter holding a white kite with thread, ready to fly it

Kites came to Europe around 1400 AD by European explorers of Asia

Kites existed around 200 BC in ancient China and Malaysia. They are dragon shaped and made of silk and bamboo.

How are kites in China

Today the custom of the kite symbolizes man's communication with God. In ancient China they believed that the higher the kite flew the more likely God would grant their wishes!

And in the Greek Christian tradition, the custom takes place on the first day of Lent, when Christians begin the physical and spiritual purification through fasting. Flying the kite symbolizes the flight of the human soul to the divine.

But kite flying was not always a religious custom.

- Search in the internet for information on the use of kites for meteorological observations and other scientific and military purposes.

Make a presentation for the next lesson

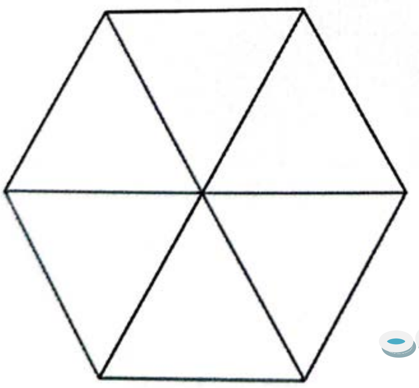
«Kites in the sky» (3)

Make your own kite (work in groups of 4)

Materials: 3 wooden rods 100cm long.

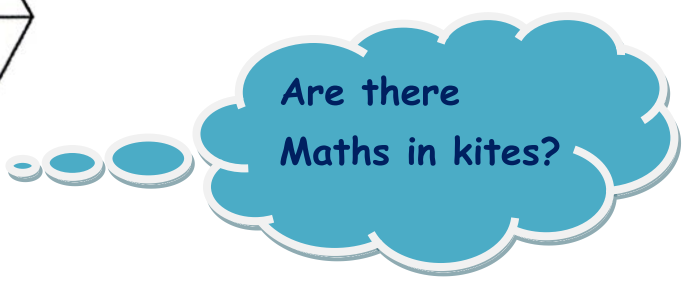
Paper

Twine, glue

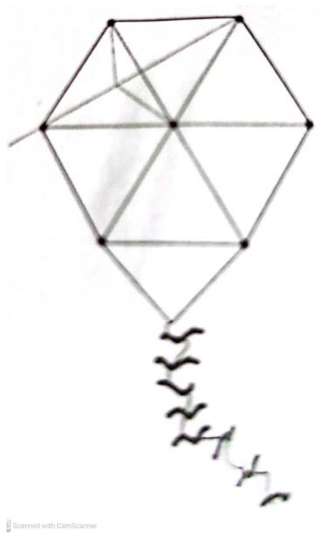


Construction instructions:

Step 1: Join the 3 pieces of wood exactly in their center to form a regular hexagon. Join all 6 edges with twine around the perimeter, to form the hexagon



Step 2: Spread the paper on the workbench and place the kite frame on the paper. Turn the paper over the perimeter string and glue it to the inner side.



Step 3: Make the scales: cut 1 piece of twine approximately 90 cm long and 2 pieces approximately 140 cm long. Tie the large piece on the upper side, at the two ends of the wood, and calculate that it will reach the center of the hexagon. There join it with the small piece, you have tied to the wood in the center of the hexagon. At the point where the two pieces of string join, attach the rest of the string for flying the kite.

Step 4: Make the tail: Tie the other big piece of twine to the lower two ends of the sticks and calculate that it will reach the center of the hexagon. Right there tie the tail at least 3 meters long.

Title: "Fixing the Christmas tree lights"

Teaching Scenario: Problem Solving and STEM

Research conducted and theories from the field of psychology suggest that students involved in problem solving learn content and thinking strategies simultaneously. The key elements of PBL are summarized below and defined as follows:

Learning is built on a complex problem that does not have a single correct answer. Students work collaboratively in groups to identify what they need to learn in order to solve the problem.

They engage in a kind of autonomous learning and then apply the new knowledge to the problem they are trying to solve.

Students take into account what they have learned and evaluate the effectiveness of the strategies they have used.

Teaching Script:

Educator/author:	Flouri Eleni
Fields of knowledge involved:	Physics, Engineering, Mathematics, Informatics, Economics, Environmental
Brief description:	.1. Trigger of interest: Students will be asked to fix Christmas lights 2.The question will be asked. 3.Build circuits in series and parallel. Worksheet 4.Correct operation of a light bulb and avoiding its destruction. Conclusions. Self - evaluation and hetero - evaluation. 5.Search for information on the environmental costs of plastics (Greece and worldwide). Worksheet . 6.Extension of the action. Implement proposals if the group of students wishes.
Underlying learning theory:	According to this theory, the following phases are followed: ✓ Trigger of interest ✓ Formulation of hypotheses ✓ Experimentation ✓ Conclusions - Theory formulation ✓ Check - Evaluation
Number of students:	15-20 students in groups of 4-5 people
Classroom organisation:	The scenario is designed to take place in the school laboratory, where there are comfortable workbenches and the necessary digital tools for searching for information. Students work in groups of 4-5 people using one computer per group.
Worksheets:	There is a worksheet for each lesson. The worksheets guide the student in carrying out the activities as well as in understanding the concepts.
Digital tools:	internet, Programming Language, YouTube.com
Proposals for further activities:	✓ It is proposed to enrich the scenario with artistic activities (STEAM): ✓ Making their own candles to decorate the school's Christmas trees
Script evaluation:	By carrying out and completing the worksheets and actively involving students in suggestions for further activities

Worksheets

Elements of Theory

Any electrical device that has two poles and is connected to an electrical circuit is called an electric dipole. When an electric voltage V is applied to the poles of an electric dipole, then an electric current I flows through it. The graph of the current in relation to the voltage is called the characteristic curve of the dipole.

From the characteristic curve of a dipole we can draw conclusions about its structure and their properties. In the case where current I is proportional to voltage V the characteristic of the dipole is a straight line passing through the beginning of the axes. Then the dipole is called a resistor. The resistance R of a dipole conductor is called the scalar size which is equal to the quotient of the voltage applied at its ends to the current current that leaks it:

$$R = \frac{V}{I}$$

The unit of measurement R in S.I. is Ω: 1Ohm=1Volt/1Ampere (1 Ω=V/A).

In electrical engineering and electronics we often use multiples such as $1K\Omega=10^3\Omega$ and $1M\Omega=10^6\Omega$

The measurement of resistance R can be carried out with instruments called ohmmeters. Ohmmeters are usually integrated into multimeters.

In general, the resistance of an electric dipole changes with the applied voltage, but there is a category of dipoles**, the resistors** for which the resistance R is constant and it is independent of the voltage applied to their ends and the intensity of the electrical current that flows through them. Ohm's law applies to resistors is expressed as follows:

The intensity of the current that flows through a resistor-metal conductor of constant temperature is proportional to the voltage applied to its ends.

$$I = R/V \text{ (with } R = \text{constant)}$$

Metal conductors behave according to the law of Ohm, as long as they keep their temperature stable.

Resistors can be connected to each other in various ways, thus creating the so-called resistor systems. In a system of resistors we call equivalent resistance of the system, a resistance that displays electrically equivalent results to the set of resistances of the system.

The two main ways of connecting resistors are:

a) **Resistors connected in series:** in this way of connection resistors in series share the same current, in other words, the current I_{tot} that enters the system passes through all the resistances.

$$I_{tot} = I_1 = I_2 = \ldots\ldots$$

The voltage applied at the ends of the resistor system is equal to the sum of the voltages applied at the ends of each resistor.

$$V_{tot} = V_1 + V_2 + \ldots.$$

The equivalent resistance to connection in series is:

$$R_{tot} = R_1 + R_2 + \ldots$$

B) **Resistors connected in parallel:** in this connection the V_{tot} voltage applied to the system is the one applied to all resistors, as well.

$$V_{tot} = V_1 = V_2 = ...$$

The intensity of the current entering the resistor system is equal to the sum of the currents that flow through each resistor:

$$I_{tot} = I_1 + I_2 + ...$$

The equivalent resistance to parallel connection is:

$$1/R_{tot} = 1/R_1 + 1/R_2 + .$$

1st Activity:

Find values of resistors that are inside the box as well as how to connect them.

<u>Objective and central idea</u>

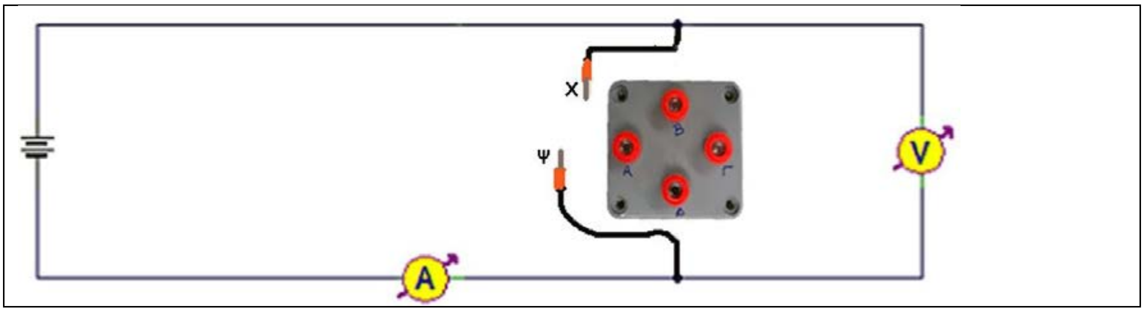
The purpose of this exercise is to experimentally find the resistance of a resistor. The design of the experiment is based on Ohm's law.

<u>Required materials</u>

1. low and high voltage power supply
2. box with unknown resistances
3. multimeters.
4. digital connector cables with metal probes

<u>Experimental procedure and processing of measurements</u>

Assemble the circuit of the image below by placing the metal probe X into the socket A the metal probe Ψ to socket B, then place the metal probes of voltmeter in the plugs of these terminals.



In the box there are two resistors

As a source use the power supply (receivers 0 to 20V).

As an ammeter use a multimeter and set its knob to Direct Current DC **(A–)** on the **2A** and plug the black jack into the hole labeled "COM" and the red jack into the hole labeled "2A" **(com & 2A)**

As a voltmeter use a multimeter and set its knob to Direct Current DC **(V–)** on the 20V and plug the black jack into the hole labeled "COM" and the red jack into the hole labeled "V" **(com & V)**

As soon as you assemble it and before switching on the power supply, call the professor's supervisor for a check.

Turn on the power supply and the multimeters. By rotating the button of the power supply set the voltage at 10V.

Place the X and Y metal probes sequentially on the connectors with the letters A, B, C, D and for each of the following combinations measure current and voltage. Before each movement of the X and Y metal probes, reset the rotating button to zero voltage (0).

The 6 possible combinations are shown in the table.

	X	Ψ
1.	A	B
2.	B	Γ
3.	Γ	Δ
4.	Δ	A
5.	A	Γ
6.	Δ	B

Current intensity I (A)	Voltage V in (V)

4a) In which combination of metal probes there is a current?

....

4b) What resistors do you think exist in the box and to which metal probes correspond their terminals? Calculate the resistance R with an accuracy of one decimal.

....

4c) How do you think they're connected?

....

4D) Design the circuit you think is inside the box

2nd Activity:

<u>Measuring the resistance of a resistor</u>

<u>Required materials</u>

1) low and high voltage power supply

2) digital multimeters

3) Resistor

4) connector cables with metal probes

Experimental procedure and measurement processing

1. Measuring the resistance of a resistor with the ohmmeter

Carefully study the multimeter elements you have (the plugs in which the jacks will be connected, as well as the scales)

Use one of the two multimeters as an ohmmeter turning the knob on the resistance measurement scale and plugging the black jack into the hole labeled "COM" and the red jack into the hole labeled "V/Ω" (**COM&V/Ω**) to measure the resistance of the first of the resistors you found in the first activity.

The value measured is: R =..............

2. Measurement of resistance of resistor by voltmeter and ammeter

A. Make and then draw a circuit by connecting the source in series (into the plugs that lie below the scale of 0 to 20V), the resistor and one multimeter as an ammeter on the 2A Direct Current scale (COM & 2A). At the same time connect the other multimeter as a voltmeter to the 20V Direct Current range (COM & V).

DO NOT turn on the power supply or turn on the circuit until you call the professor to check.

Design Circuit:

Turn the rotating button of the power supply full left at zero and then turn on the power supply.

Change the voltage of the source starting from 4 V initial value, up to 12V by noting down in the table, the indications of the instruments.

Take 6 measurements and complete the table

	Voltometer reading in V (voltage)	Ammeter reading in A (current intensity)
1.		
2.		
3.		
4.		
5.		

6.		

3. Based on experimental values in the table, draw on milimetre paper the graph of the current flowing of the resistor in relation to the voltage applied at the ends of I=f(V). This is the characteristic curve of the resistor.
4. Calculate the slope **k** of the characteristic curve of the resistor and then calculate the value of the unknown resistor, **k = 1/R**.

....

R =...............

5. If this differs from the one calculated with the help of the ohmmeter, explain where this difference may be due.

....

6. Measure the resistance of the lamp that the Christmas lights have

R =..............

7. Please explain why the lights are connected in order.

....

8. If we want to put 10 such lights on a parallel connection find the value of the resistance that I have to connect in series with them, in order to work properly with a 2V battery.

....

9. Measure the time it takes to change a lamp from the lights and recheck if it's broken.

T=.......sec

10. Build the flow chart to create a program that will calculate the time required for the burnt lamp to be found.

…………………………………………………………………………………….

11. Collect information about plastics and write the time that it takes to degrade.
…………………………………………………………………………
12. Fix the Christmas lights in parallel and find the way to turn on and off every 1sec.
…………………………………………………………………………………….

Bibliography

Themes of the EUSO competition by EKFE Karditsa - http://ekfe.kar.sch.gr

WAXING WITHOUT TIRING THE LUNGS & CREATING A GOLDEN RAIN

TEACHING SCENARIO: CHEMICAL REACTIONS AND STEM

In the vast world of the theory of Chemistry, chemical reactions are essentially the application of the knowledge of this theory.

Students are involved in carrying out Chemical reactions while learning strategies of the correct and clean work required in a Chemistry laboratory and the planning of thinking. The key elements of the PBL are briefly listed below and are defined as follows:

Learning is built on the application of theoretical knowledge .

The students work collaboratively in groups with the aim of group organization, cooperation for the successful execution of chemical reactions.

They are involved in a kind of autonomous learning to achieve their purpose .

The students evaluate the effectiveness of the strategies they used.

DIDACTIC SCENARIO

1) THE EXTINGUISHING OF CANDLES WITHOUT TIRING THE LUNGS 2) CREATION OF GOLDEN RAIN	
TEACHER:	PILINI ELENA
FIELDS INVOLVED:	Chemistry, physics , mathematics, computer science, economy. environment
DURATION OF IMPLEMENTATION:	4 hours
CONNECTION WITH A DETAILED CURRICULUM:	The script is suitable for high school .
OBJECTIVES:	**COGNITIVE OBJECTIVES:** 1. Understanding and consolidate of basic concepts (what chemical substances are the products and which are the reactions) 2. Understanding new concepts (differentiation of physical and chemical properties between products and reactants) 3. To establish experimentally the change in physical and chemical properties between products and reactants 4. To connect chemistry with everyday life 5. Calculate the necessary quantities of chemical substances for the manufacture of solutions. 6. To think and organize which utensil of the laboratory will be needed for the execution of the experiments

	7. To find out how the atoms of the elements are connected in the compounds and what variations in their bonds happen in order to produce the products with the help of the program chemsenseanimator. **SKILLS OBJECTIVES:** 1. flexibility of use the laboratory 2. flexibility in calculating the quantities required. **METHOD OF WORK:** 1. working in groups, 2. evaluation and justification of observations. 3. Discussion about the environmental cost of the inexhaustible discharge of chemical waste into the environment.
SHORT DESCRIPTION:	**AN INSPIRATION OF INTEREST:** • Students will be asked to extinguish the wax or candles by performing a chemical reaction and not to blow them out (worksheet 1) • Students will be asked to make golden rain (worksheet 2) • Applying knowledge of chemistry and physics, they should find the gas that extinguished the fire. They also must find the correct size and shape of utensil in order to have success • Applying knowledge of chemistry at the 2nd experiment they will prepare sediment and find out which one it is. • Using the program chemsenseanimator they will try to create the molecules of the compounds of the above experiments and the transformations that occur. **FORMULATION OF RESEARCH:** • Search for information on the environmental cost of the inexhaustible discharge of chemical waste into the environment if they don't calculate the correct quantities and there is no organized group work. • **CONCLUSIONS AND EVALUATION.**
UNDERLYING THEORY OF LEARNING:	According to the model of discovery / exploratory learning. followed phases are : 1. a spark of interest 2. formulation of hypotheses 3. experimentation 4. conclusions – theory formulation evaluation

NUMBER OF STUDENTS:	25-27 students in groups of 4-5 people
CLASS ORGANIZATION:	The scenario is designed to take place in the school laboratory, where there are comfortable workloads, the necessary utensils and computers.
DIGITAL TOOLS:	INTEPNET, PROGRAMME ChemSenseAnimator, YouTube.com
WORKSHEET	There is a worksheet for each experiment. the worksheets guide the student in the execution of the activities as well as in the understanding of the concepts.
SCENARIO EVALUATION:	• Implementation and completion of the worksheets • active involvement of pupils in the proposals for further activities

WORKSHEET 1
WAXING WITHOUT TIRING THE LUNGS

REAGENTS:

1. 200 ml of Ethanoic acid solution (acetic acid or vinegar CH_3COOH
2. 40gr Sodium bicarbonate (soda) $NaHCO_3$

INSTRUMENTS/EQUIPMENT:

1. three reso candles
2. a glass stick
3. an extractive funnel
4. a conical vacuum bottle
1. Water level device (alphadolasticho)
2. 250 ml brewing cup
3. silicone adhesive or wire
4. cork

FOR STARTERS: Stick (or attach) the three candles to the glass rod at different levels.

In the refining funnel add the vinegar. Add the soda to the conical flask. Put on thetop of the conical flask the cork in which a hole has been created so that you can place the extractive funnel. Connect the first edge of the water level device to the conical flask and the other one place it in the cup of zesis. Place also in the glass of zesis, the glass stick with the candles lit. Open the faucet of the funnel.

PROCEDURE:

1. Why candles go out one by one?
   …………………………………………………………………………………………………
2. Why the candle closest to the bottom go out first.?
…………………………………………………………………
3. Pour the contents of the glass into a lit candle. Why the fire extinguished again?
   ……………………………………………………………………………………………………..
4. write the chemical equation of the reaction that occurs.
   ……
5. Use the programm ChemSenseAnimator to show the course of the reaction.
   ……
   .

WORKSHEET 2

CREATING A GOLDEN RAIN

REAGENTS:

1. Lead Nitrate **$Pb(NO_3)_2$** (3g)

2. potassium iodide **KI** (3g)

INSTRUMENTS/EQUIPMENT:

1. Spherical bottle 250ml
2. Glass beaker 250ml (2)
3. filter paper
4. filter funnel

EXPERIMENTAL PROCEDURE:

For the experiment they should be prepared at least 1,5g lead iodide.

1. Calculate the required masses of the potassium iodide and lead nitrate. Write the calculations.

……

PREPARATION OF SOLUTIONS:

A. SOLUTION OF POTASSIUM IODIDE

in a 250ml glass beaker dissolve in 100 ml of water the required quantity potassium iodide

B. LEAD NITRATE SOLUTION

In a 250ml glass beaker dissolve in 100 ml of water the required amount of lead nitrate.

PROCEDURE:

.Add the potassium iodide solution in droplets to the lead nitrate solution. It starts to form a yellow precipitate at the bottom of the glass.

Upon completion of the reaction, filter the solution and collect the sediment in the filter.

Put 100 ml of water in the spherical pottle and dissolve the sediment, fill in the required water and heat the final solution until the sediment is completely dissolved.

2. Cool the solution of the spherical bottle.
3. Write the chemical equation of the chemical reaction that occurs.

…………………………………………………………………….

4. Write your impressions about the result

…………………………………………………………………………….

5. Use the programm ChemSenseAnimator to show the course of the reaction.

……

SCIENCE ESCAPE ROOM

Escape rooms are puzzle and action games. Action is created by locking players in a room. The way out requires solving some puzzles, focusing on the player's logic. The game mechanism is based on the fact that the player is put in a negative position/situation, from which he naturally wants to get out and this is his motivation for playing the game. Players, always in teams, discover clues, solve puzzles, and perform tasks in one or more rooms in order to achieve a specific goal (usually escaping the room) in a limited amount of time. To help solve the puzzles, they rely on a starter script, which describes the problem in a concise and clear way and contains "hidden" and coded clues, which guide the players' investigation. Facilitating and guiding players as the game progresses is commonplace in escape rooms. Usually, there is a leader (game master) who gives clues, which facilitate the solving of the puzzles through camera or microphone or live or through notes (Wiemker et al, 2015).

Escape rooms ideally combine the telling of a story (game script), the provision of tools (hardware, software) and the richness of the player's choices and activities, which shape the development and outcome of the game. The whole dynamic of the game is based on team dynamics, critical thinking and active player participation. The teamwork and cooperation required undoubtedly strengthen the communication relationships of the students. In addition, risk-taking, attention to detail, lateral thinking, good time management, creativity and determination are enhanced.

The science escape room described here is a combination of two learning categories based on GBL and DGBL games. Escape rooms do not belong to the category of traditional games, because they require a wide variety of knowledge and skills from the players, active participation, teamwork and cooperation. It is these characteristics that make them suitable for use in education.

This particular Science Escape Room was designed with an emphasis on the combination of teaching and entertainment. Playfulness usually does not go well with didactic guidance. Taking into account that the students should have the feeling of the player and not the student, we took care in the planning of the activities and especially in the decoration of the room (school science laboratory) and the choice of music that students participate.

Science Escape Room puzzles include simple lab experiments using lab instruments and reagents and computer activities. Virtual science labs were used for the computer-based activities. The virtual laboratory functions as a flexible methodological tool, which facilitates the application of alternative teaching techniques and contributes substantially, together with other sources of information, to the achievement of pedagogical goals.

Teaching Scenario

«Science Escape Room»	
Teacher/author:	Angeliki Tenente
Fields of knowledge involved:	Science, Computer science, Literature
Duration of implementation	1 teaching hour. The script could be enriched with additional activities
Links to Analytical Study Program	The script is suitable for application in General Senior High School, in all classes. With appropriate adaptations, it can be applied to Junior High School and 5th and 6th Grade.
Aims and objectives:	Cognitive objectives: • understanding of basic biology concepts (blood type, microscopy, blood transfusion), • acquiring knowledge about the organization and operation of research laboratories and the profile of the specialties employed in them, • to establish experimentally the conditions for identifying a patient's blood type and choosing the right blood donor. • connecting school knowledge of biology with applications of everyday life. Skill Objectives: • Use of different materials, • Use of electronic devices (PC, tablet) • Development of argumentation skills and expression of opinion on scientific topics. • Cultivating skills of cooperation, teamwork, initiative and interpersonal communication. Attitudes/behaviors: • work in groups, • cultivating positive attitudes towards science and research. • Cultivating positive attitudes towards blood donation.
Summary:	1. The team of players is given a starting scenario, which takes them narratively into the laboratory space of a research center, where they are trapped and threatened by a new dangerous microorganism. In order to avoid

	the contamination, they must solve 3 puzzles to find the code that unlocks the lab entrance. Following the startup script step by step, they implement 3 science experiments. 2. Experiment A: microscopic observation of human cells. Using an optical microscope, observing different tissue samples and identifying a blood sample. 3. Experiment B: The team of players is asked to identify the pathogenic microorganism using the information in the scenario, microscope slides, and protoplasts. 4. Experiment C: Virtual laboratory (simulation of typing of an unknown blood sample): A tablet was used at each workbench and the website: https://www.sciencefromscientists.org/game/bloodtype.html 5. From the results of the three experiments the players generate the three-digit code that unlocks the room.

Underlying learnig theory:	Application of exploratory learning through the scientific method for solving puzzles. The stages of the scientific method that apply are: • Observing (seeing, hearing, touching) • Question (why, how) • Hypothesis, prediction (what do I think will happen if…) • Exploration (I have to experiment and be creative) • Conclusion (I compare the result with my initial hypothesis) • Communication (sharing my findings)
Number of students:	Game masters: 4 students. Players: group of 4-5 students from any school class.
Class organization:	The scenario is designed to take place in the school laboratory, where there are comfortable workbenches and the necessary digital means to search for information. The action is coordinated and supervised by a group of 4 students, the game masters. The game is played each time by a group of 4-5 students.
Work sheets:	There is a starter script given to players at the beginning of the game.
Digital tools:	Sciencefromscientists.org, tablets
Suggestions for further activities:	It is suggested to enrich the script as follows: • New experiments and new launch scenarios • Creation of a poster and other multimodal material to promote the action
Evaluation:	By playing the game and successfully completing it within 20 minutes. Finding the code that unlocks the room is considered a success.

TEACHING SCENARIO: STEM & GAMIFICATION – BLOODY GAMES

In this teaching scenario, the subject of teaching is the blood types of the ABO system, the identification of an unknown blood sample and the selection of the correct blood type in a hypothetical blood transfusion. For the application of the worksheet, the teaching of the basic theory of blood types and permissible transfusions must have preceded, in another teaching hour. The understanding and consolidation of this theory will be tested by the worksheet of this scenario.

Learning techniques that include gamification have been incorporated into the teaching material, such as:

1. There is a hypothetical scenario that introduces students to an imaginary emergency situation to which they must respond and find a solution using their knowledge about blood types.

2. The worksheets and in general all the stages of the scenario implementation are in the form of a game, where the completion of one process creates the trigger for the start of the next process.

3. Rewards and challenges are used in each stage of the activity, such as the successful completion of blood identification, the restoration of the patient's health, etc.

4. Teaching in the school laboratory and the use of a virtual laboratory are combined. The virtual lab reinforces the hypothetical scenario and activates students' interest and engagement in completing the activities.

Gamification is used in this teaching scenario as a tool to activate the interest and enhance the interaction of the students with each other and with the teaching content. The main purposes of the game are the optimization of learning results and, of course, entertainment.

Teaching Scenario

«Bloody games»	
Teacher/author:	Angeliki Tenente
Fields of knowledge involved:	Science (Biology), Computer science, Literature
Duration of implementation	1 teaching hour.
Links to Analytical Study Program	The scenario is suitable for application in General High School, in class A, where the circulatory system and blood types are taught. With appropriate adaptations it can also be applied to Junior High School.
Aims and objectives:	Cognitive objectives: • understanding of basic biology concepts (blood types, blood transfusions), • practicing in school lab the procedure of identifying a patient's blood type and choosing the right blood donor. • connecting school knowledge of natural sciences with applications of everyday life. Skill Objectives: • Use of different materials, • Use of electronic devices (PC, tablet) • Development of argumentation skills and expression of opinion on scientific topics. • Cultivating skills of cooperation, teamwork, initiative and interpersonal communication. Attitudes/behaviors: • work in groups, • cultivating positive attitudes towards science and research. • Cultivating positive attitudes towards blood donation.
Summary:	1. Students work in small groups of 3-4 people. Each group is given a starting scenario, which describes a car accident and the need to treat an injured person. Students in the role of the doctor have to identify the patient's blood type and select the correct blood type for the transfusion to be performed in the operating room. 2. Step A: Each group is given an unknown blood sample (fake blood) and anti-A, anti-B and anti-Rhesus antibody sera. By observing the reaction of blood and each serum, students identify the patient's blood type. 3. Step B: Virtual lab (simulation of typing of an unknown blood sample): A tablet is used at each workbench and the web address: https://www.sciencefromscientists.org/game/bloodtype.html 4. Using the result of step A, each group of students discuss and decide which transfusions are permissible for their patient.

Underlying learnig theory:	Application of exploratory learning through the scientific method for solving puzzles. The stages of the scientific method that apply are: • Observing (seeing, hearing, touching) • Question (why, how) • Hypothesis, prediction (what do I think will happen if…) • Exploration (I have to experiment and be creative) • Conclusion (I compare the result with my initial hypothesis) • Communication (sharing my findings)
Number of students:	Groups of 3-4 students. It can be implemented in one whole class or in mixed groups of students from different sections of the A class.
Class organization:	The scenario is designed to take place in the school laboratory, where there are comfortable workbenches and the necessary digital means (tablets).
Work sheets:	There is a worksheet that includes the starting scenario and the activities that each team should implement. A worksheet is given to each group of students.
Digital tools:	Sciencefromscientists.org, tablets
Suggestions for further activities:	It is suggested to enrich the script as follows: • New experiments and new starting scenarios • Creation of a poster and other multimodal material to promote the action
Evaluation:	The script is structured so that the successful completion of each step allows the correct execution of the next. Successful completion of the activities implies a positive evaluation of the implementation of the scenario.

Tips for teachers:

1. Simulated blood was used for the game (the use of blood in the school laboratory is prohibited). Mix milk with several drops of red food coloring until the mixture turns a dark red color.

2. For the anti-A, anti-B and anti-Rhesus antibody sera, water or white vinegar was used depending on the blood group we wish to obtain.

After pre-deciding which blood type he wants to appear on each laboratory bench, the teacher fills the bottles of antibody sera with water or vinegar. The reaction that the students will observe to decide the blood type in the unknown sample, is actualy a reaction of denaturation of milk protein in the presence of acid. If, for example, we want blood group A+, in the bottle with anti-A serum and in the bottle with anti-Rh serum we will put white vinegar, while in the bottle with anti-B serum we will put water.

BLOODY GAMES

A serious car accident just happened!

Five injured people with unknown blood type are urgently admitted to the hospital. Patients have to undergo surgery and need a blood transfusion.

Try the simulation in the virtual lab to remember how to find the blood type.

Their lives are in your hands!

Each workgroup will standardize one (1) blood sample according to the ABO system and Rhesus factor.

On the lab bench is a blood sample and antibody sera!

- Take 2-3 drops of the unknown blood sample with the dropper and put it in the three petri plates on your bench.
- In the first plate, add 2 drops of the anti-A antibody serum,
- In the second plate, add 2 drops of the anti-B antibody serum
- In the third plate, add 2 drops of anti-Rh antibody serum.

We check each plate for an obvious reaction.

We record the result in the table below.

Find the blood type!				
Blood sample	**Blood +anti-A serum**	**Blood + anti-B serum**	**Blood + anti-Rhesus serum**	**Blood type**

What blood types can you safely transfuse your patient?

8.5. ITALY

In the educational path of European students, STEM disciplines occupy a leading role in many higher education institutions. In Italy, for example, they represent a fundamental nucleus in the case of the various scientific high school courses currently active (scientific high school, scientific high school of applied sciences and sports high school), but also in technical training institutes such as in the case of technicians, in particular those relating to the Technological sector, where despite the variety of curricula available (Mechanics, Mechatronics and Energy; Transport and Logistics; Electronics and Electrical Engineering; Computer Science and Telecommunications; Graphics and Communication; Chemistry, Materials and Biotechnology; Fashion System; Agriculture, Agro-food and Agro-industry; Construction, Environment and Territory) the STEM disciplines represent an important transversal training base for every possible curriculum.
Based on the analysis of the needs of teachers and students examined in chapter 5th of the guide, the following are some proposals for activities designed to stimulate the learning of topics regularly addressed during the teaching of the various disciplines through the integration, within the normal teaching activity, of the gamification method in order to encourage learning based on play and fun, in the belief that an experiential approach to the didactic-educational process favors the active involvement of students and consequently a broader understanding and easier memorization of the topics studied.
Topics covered in different fields and years will be specifically examined, but always taking as a case study that of students in the second cycle of education, in particular students enrolled in scientific high schools or technical institutes. The disciplines of reference are Mathematics, Physics, Natural Sciences, Computer Science, valid for both types of institute, and Electronics and Electrical Engineering, pertaining to the course of study proposed by the technical institutes.

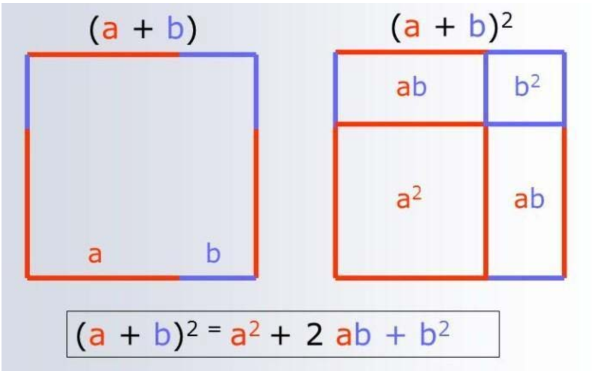
Template 1

Activity title	**Remarkable identities displayed graphically**
Subject	Mathematics.
Topic covered	The remarkable identities.
Recipients	First year students (of any upper secondary school).
Goals	• Justify and understand the rules for calculating the main remarkable identities (“square of binomial”, “square of trinomial”, “cube of binomial”, “addition multiplied by difference”); • Understand the link between algebra (abstract aspect) and geometry (intuitive aspect). • Encourage students to learn and memorize formulas with the help of visualizing remarkable identities, through geometric construction
Detailed description of the activity	If you want to prove the above four formulas about remarkable products, proceed as follows: the class is divided into four groups, each of which is assigned a formula;

<table>
<tr><td></td><td>
each group is also given a figure of reference;

making use of suitably prepared colored cardboard cut-outs of square and rectangular shapes, the groups are asked to reflect on which and how many cut-outs to use, so that, placed close together, they overlap perfectly with the reference figure.

Example: the group that has to prove the formula of the square of binomial (after a certain period of reflection) will have to understand that, given a square of side $(a+b)$, two squares are needed, one on the side □ and the other to the side b and two rectangles of equal sides a, b thus arriving at the well-known formula:

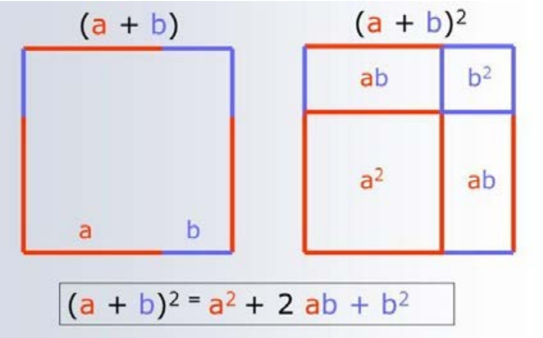


Similar work will be requested of the other groups.

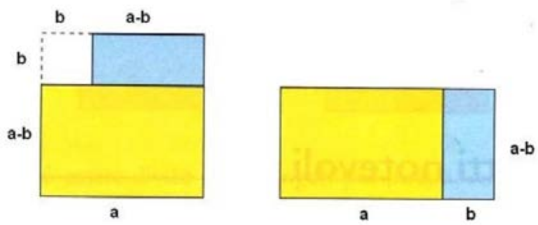
In doing so, the students will understand firsthand and in an active way how there is always geometric intuition behind the algebraic formulas, which, otherwise, could be excessively abstract.
</td></tr>
<tr><td>Times</td><td>1h divided as follows:
- ½ h for deduction of own formula
- ½ h for the explanation to the rest of the class.</td></tr>
<tr><td>Spaces</td><td>Teaching room.</td></tr>
<tr><td>Tools used</td><td>Colored cards.</td></tr>
<tr><td>Verification method</td><td>Teamwork.

Each group initially works on the deduction of the relevant product assigned, and subsequently explains it both geometrically and algebraically to the other groups.</td></tr>
<tr><td>Useful link or bibliography</td><td>Textbook.</td></tr>
</table>

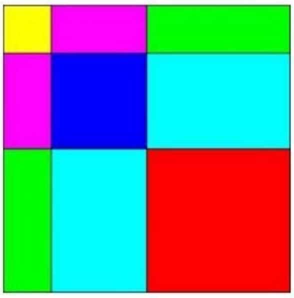
Binomial square: $(a+b)^2 = a^2 + 2ab + b^2$



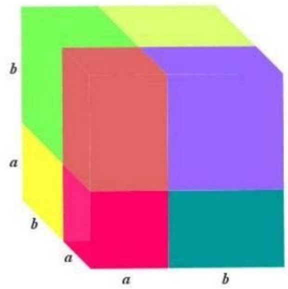
Sum by difference: $(a+b)(a-b) = a^2 - b^2$



Trinomial square:
$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc$



Binomial cube: $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$



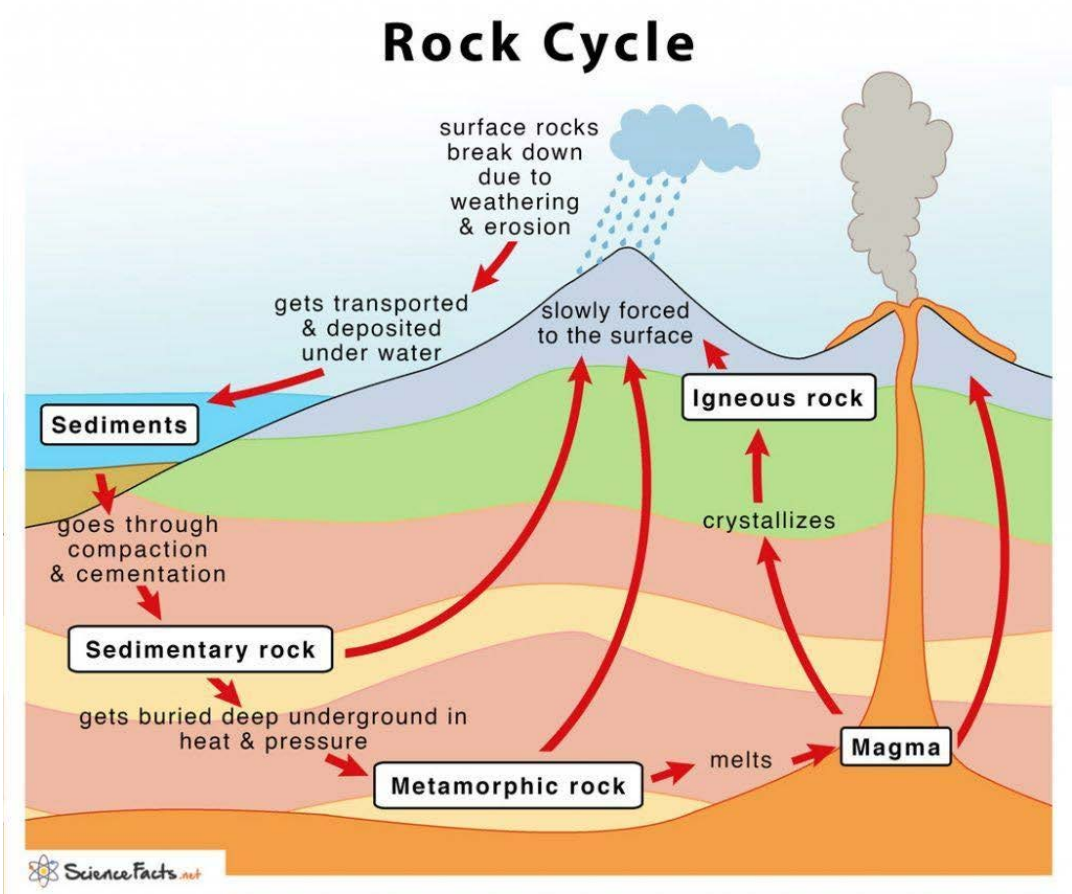
Template 2

Activity title	Fit with PHYSICS
Subject	PHYSICS
Topic covered	Rectilinear motion and its representation in the space-time graph
Recipients	Students of the second year of the scientific high school
Goals	• Knowing how to apply the hourly laws of motion to the real context • Knowing how to graphically represent the results obtained from the observation of reality • Understand the geometric meaning of the inclination of the straight line which it represents in uniform rectilinear motion, • Knowing how to identify the type of motion by reading a space-time graph • Knowing how to use application software to represent and create graphs • Knowing how to work in cooperative learning with classmates.
Detailed description of the activity	The class is led in an open space by the teacher. Three pupils of the class place an adhesive tape of a pre-established length (e.g. 21 metres) on flat and straight ground;

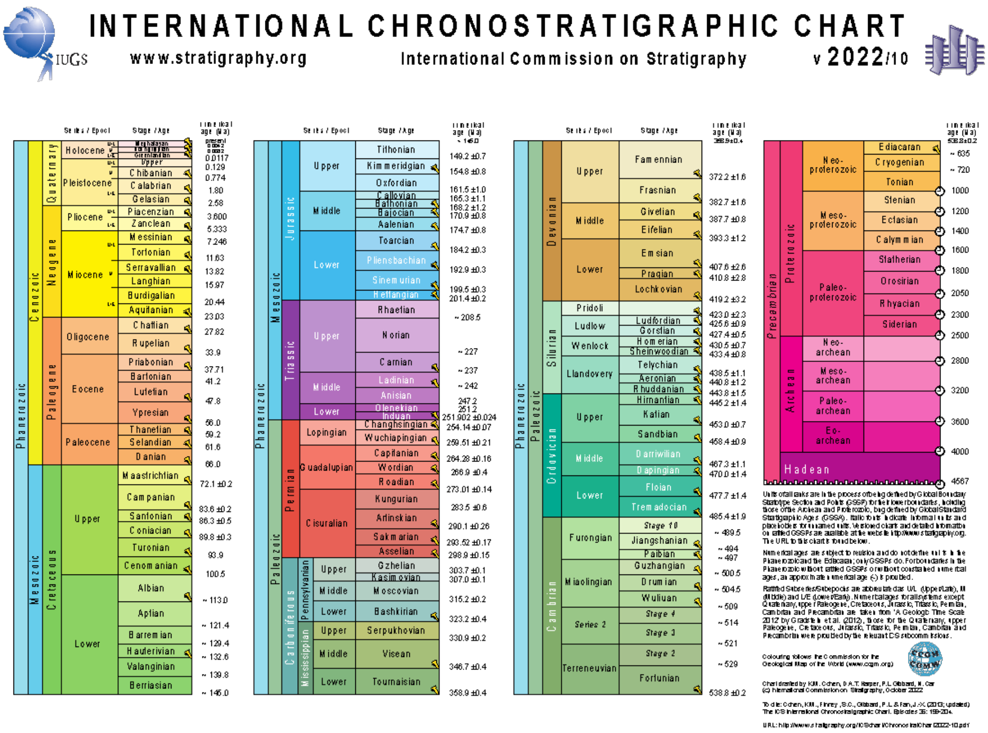
	then starting from the origin of the tape, with the tape measure and felt-tip pen, highlight lines on the tape at regular distances from each other (e.g. 3 meters), which will be indicated with the positions S1, S2, S3, S4, S5, S6, S7. A fourth student of his choice will have to travel the straight line at least three times with different pace: 1. irregular trend 2. smooth and slow pace 3. smooth and fast pace The rest of the class has the task of detecting the times related to the passage in the seven indicated positions with the stopwatch of the smartphone. Everyone will therefore have to write down in the notebook the seven instants corresponding to the positions t1, t2, t3, t4, t5, t6, t7 creating a corresponding table. All this must be repeated 3 times, in reference to each gait. Once the outdoor experience is completed, the class will go to the computer lab where each student will have a computer and using the data collected will have to create a space-time graph in which they will compare the data relating to the 3 observed situations. Three different straight lines corresponding to the three situations analysed, must be obtained in the same graph. The results obtained will be shared and discussed with the rest of the class.
Times	120 minutes
Spaces	Open space (e.g. school playground), Computer lab.
Tools used	Scotch tape Felt-tip pens Metro Smartphone Calculator notebook, pens, Software to create graphs (excel,..)
Verification method	Report on the observed experience and creation of the space-time graph

Template 3

Activity title	**From urban geology to geological time**
Subject	Natural Science
Topic covered	Rocks, geological time, the lithogenetic cycle
Recipients	Third class scientific high school
Goals	• Learn and recognize rocks;

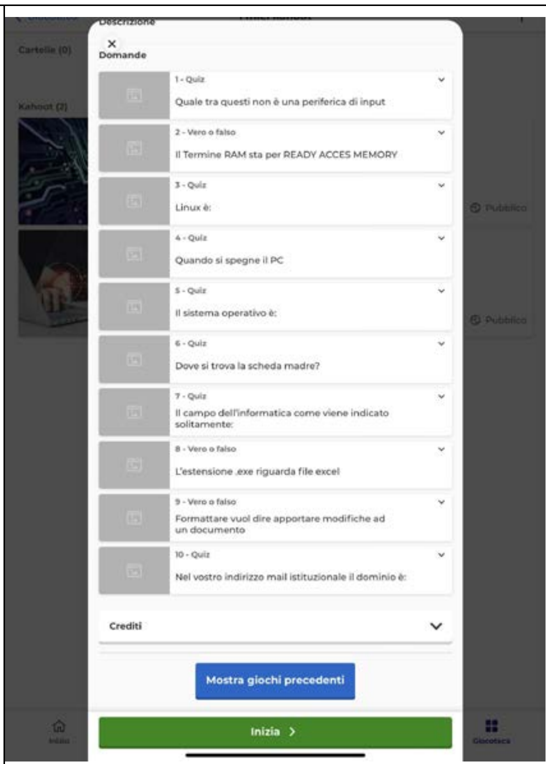
	● Acquire awareness that every type of rock is part of the lithogenic cycle; ● Acquire awareness that ornamental stones have their own time (age of formation) and space (place of extraction). ● Understand that the natural resources that make up the ornamental stones have a historical geological memory and, therefore, represent an outdoor educational laboratory. 
Detailed description of the activity	The activity includes an outdoor lesson to be carried out during an educational outing in the urban municipal area to discover the geological nature of the ornamental stones that characterize churches, monuments, minor cobbled streets.  In the initial phase, the teaching activity and its objectives will be presented by the teacher; the students will then be divided into working groups of a maximum number of 4/5 students per group.

	The necessary materials are defined (topographic maps, colored pencils, photo and video tools) and a sub-area of study is assigned to each group. This is followed by the didactic excursion in the study area (municipal area); The students are then invited to organize and classify the material collected previously in the school laboratories and to elaborate the material collected in the previous phase
Times	4 h: - 2 h: presentation of the teaching activity with definition of the objectives; division of the class into work groups and definition of the necessary materials (topographic maps, colored pencils, photo and video tools), assignment of a sub-study area for each group: the didactic excursion in the study area follows (municipal area); - 1 h: organization and classification of previously collected material (activity carried out in school laboratories); - elaboration (group) of the material collected in the previous phase performed as an activity to be carried out at home; - 1 h: presentation of the works by the groups
Spaces	● Institute scientific laboratories ● classrooms ● computer classroom
Tools used	● Lim ● Geological maps of the regional and municipal territory ● Rock samples present in the scientific laboratory and collected during the educational excursion
Verification method	Teamwork Each group produces a paper reporting the study of the assigned area. The paper will also concern the correct placement of the rocks indicated in the lithogenic cycle and will attribute the appropriate scientific value to the area.
Useful link or bibliography	https://www.isprambiente.gov.it/ textbook



Template 4

Activity title	**"Who Wants to Be IT"**
Subject	ICT (information and communication technology)
Topic covered	Introduction to information technology and the processing system
Recipients	First grade students (any address)
Goals	● provide students with the basic concepts to deal with the study of computer science mainly analyzing what are the hardware and software components of a processing system including memories. ● Have the student begin to become familiar with the technical terms related to the architectural components of the PC. ● Knowing how to distinguish the various devices knowing their functions.

<table>
<tr><td>Detailed description of the activity</td><td>


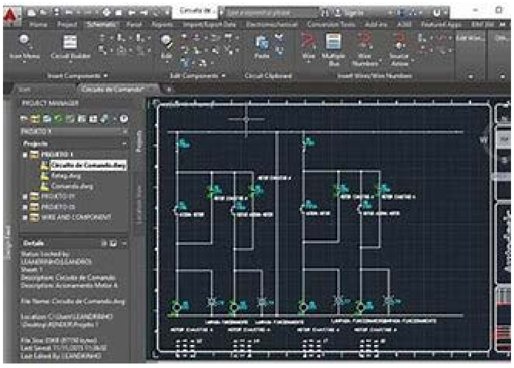
With a brainstorming activity we begin to introduce the concept of information technology, now in common use in order to understand the overall level of the class.
With a frontal lesson, the teacher explains in detail the functioning of the various peripherals with practical examples present in the laboratory.
At the end of the above activity, the class will be divided into groups of 3/4 students with heterogeneous backgrounds in order to form teams that will "clash" through the quiz software kahoot built with ten questions divided into multiple answers and V/F.
At the end of the ten questions, a ranking will be formed which will evaluate the preparation of each group.
The activity will also be carried out using the students' personal devices in order to raise students' awareness of the conscious use of devices in the school environment.
After each answer there is a short discussion on the subject of the question.

</td></tr>
<tr><td>Times</td><td>2h (1h for brainstorming activity and 1h for quiz)</td></tr>
<tr><td>Spaces</td><td>Multimedia laboratory</td></tr>
<tr><td>Tools used</td><td>PC supplied by the school and personal devices</td></tr>
</table>

Verification method	Ranking compiled by the software on the basis of correct answers and speed of execution.
Useful link or bibliography	https://create.kahoot.it/details/4a51279d-36b4-4c84-ad83-09150746b1e0

Template 5

Activity title	**Electrically**
Subject	Electrical engineering and electronics
Topic covered	The electrical circuits
Recipients	Third year students of industrial technical institutes, electrotechnical articulation, transport and logistics
Goals	• Understand how electrical circuits work • Know how to recognize the electrical components, their functioning and the appropriate insertion in the circuit. • Be able to distinguish the various users with their effects on current and voltage. • Knowing how to correctly insert the measuring instruments of the main electrical quantities. • Know and recognize the 3 fundamental quantities of electrical engineering with related laws that concern them. • Being able to light a flashlight.
Detailed description of the activity	Each student is given an educational kit with the aim of building a perfectly functional electrical circuit that turns on a light bulb and verifies some of the fundamental laws of electrical engineering, namely OHM's first law (V=IR) and Joule's law (P=VI). to verify these laws it is also necessary to have suitable measuring instruments such as ammeters, voltmeters, wattmeters and multimeters. A specific software is also set up for the digital verification of what the pupils have done manually. Activity example: • The students create a simple circuit with the aid of breadboards (also called waffle in electronic jargon; in Italian it is sometimes called breadboard or test base) which is a tool used to create prototypes of electrical circuits. Unlike the breadboard, which is a printed circuit (on a copper-plated base) on which the components and connections that form the prototype are soldered (and which is therefore difficult to reuse), the breadboard does not require soldering and is completely reusable (and therefore used especially for temporary circuits). Although it is normally used for prototyping simple circuits, it can also be used to test entire computers. • After building the circuit with the breadboard, using resistors of different values in various configurations (series and parallel), the goal is to validate Ohm's law and then calculate the current circulating in the circuit (which is connected to a

	generator of voltage) and calculate the power absorbed by the resistors (using Joule's law). • Using measuring instruments such as ammeters and wattmeters, students will be able to carry out experimental measurements of electrotechnical laws verified with theoretical calculations. • Finally, having done this, the students will verify what they obtained experimentally with the use of a dedicated software, for example AUTOCAD electrical, which is a simple electrical design program, widely used in the field of electrical engineering, by professionals, installers and students. Students will use the classic CAD drawing tools to graphically represent the circuit, inserting any other significant element of their circuit (voltage generators, resistors, batteries, etc.) from the appropriate tool bar. They will assign the appropriate values to the electrical quantities of interest and will display, through special calculation windows, the value of the unknown quantities sought (e.g. electric current and power).  **FIG: es. screenshot of autoCAD electrical**
Times	2 h
Spaces	School laboratory of electrotechnics and electronics
Tools used	• Conducting threads • resistors • pile • generators • amperometers • voltmeters • wattmeters • software AUTOCAD electrical • pc • paper reports for the reports • breadboard
Verification method	Practical verification, with written report on the experiment carried out.

Useful link or bibliography	https://www.edutecnica.it/elettrotecnica.htm BreadBoard What It Is And How It Works - Andrea M Blog (andrea-m.me) AutoCAD software | Overview and Pricing | Autodesk

8.6 LITHUANIA

Topic	**Gingerbread House for Christmas**
Teacher of Mathematics	Jovita Vainauskienė
Teaching subjects	Mathematics, Chemistry, Computer Science, Economics, Food Technology
Duration	6 lessons
Adapted for	9 Grade
Aims and objectives:	Chosen a recipe, bake a ginger biscuit house for Christmas and create a business plan.
Lesson progress	Students are divided into groups of 4-5; 2 students are responsible for making the stencils, 2 for buying the products, 1 for photographing all the stages of the project, and presenting the group's work in Microsoft Power point.
Assessment of students	Students are graded on the quality of the baking gingerbread house, aesthetics, teamwork, calculations, group work and presentation.

Process: 1. 1. find a recipe for ginger biscuits, which will be used to bake the gingerbread house. Two pupils draw stencils of the walls, roof and base of the gingerbread house, calculate the area of the gingerbread house, and use the data to estimate whether the products in the recipe book will be sufficient. In the meantime, the other two members of the team go to the shop to buy the products. Since the class will be baking 5 houses, the pupils calculate before going to the shop how cheaper it is: to buy the products for each team separately or to buy them all together, and then share the products.

Recipe:

- 250 g soft butter

- 150 g brown sugar

- 150 ml golden syrup (can be replaced by honey)

- 2 eggs

- 1 teaspoon ground cardamom and ginger

- 0,5 tsp salt

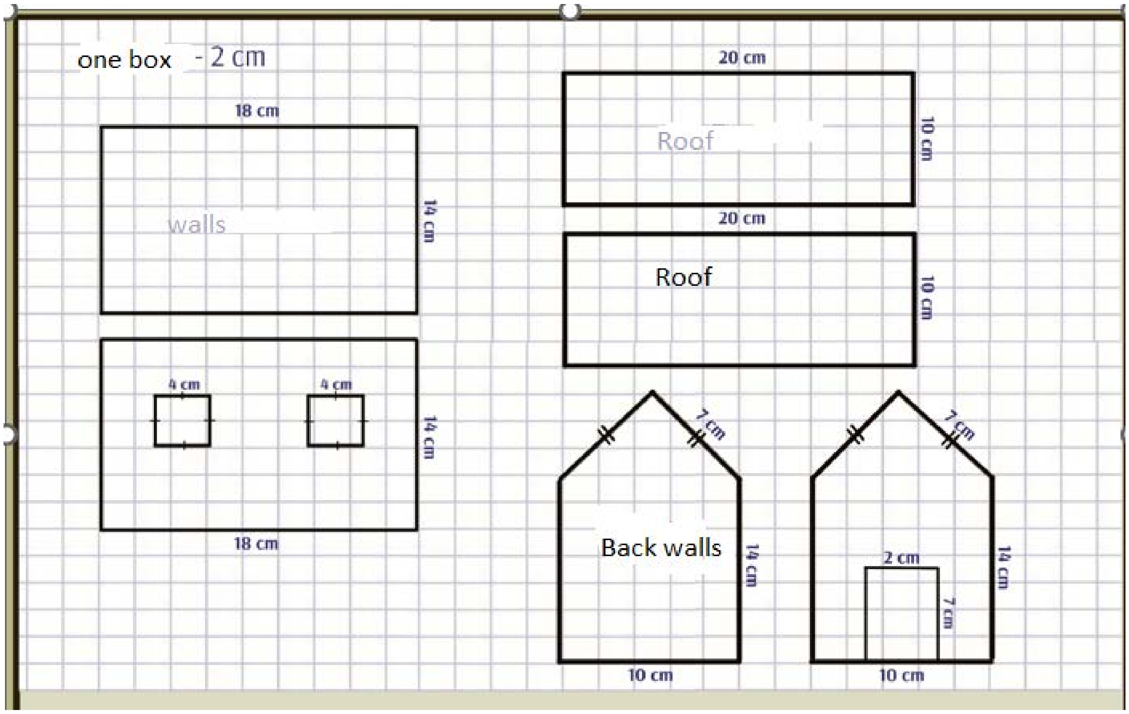
- 650 g flour (and a little more)

- For the glaze:

- 1 egg white

- 200 g icing sugar

- a splash of lemon juice



In addition to the basic products for the "house", you will need: cake decorations, small sprinkles, food colouring, sweets, icing for the walls.

2. Baking process: listening to the explanations of the technology teacher, the pupils mix the dough and bake the 'houses'.

TASKS AT WORK:

a) Using the rectangular and triangular area formulae, calculate the area of the walls of the 'house' and the volume of the 'house' using the prism volume formula.

b) Students write down the chemical formulae for sugar, salt, oil, vinegar, water. Discuss, observe, and write down the chemical reactions that take place when soda and vinegar are mixed. What chemical reaction takes place when a cake is baked. Write the equations for the reaction.

c) A kilo of flour costs €1.20. A shop has announced that it will reduce the price of flour by 25%. How much will 2 kg of flour cost? How much would the products of the "house" be cheaper if you could buy everything at a 20% discount?

d) One group has decided to increase the length of the base of the 'house' by 20% and decrease the width by 20%. How did the area of the base change (increase or decrease) and by what percentage?

e) Based on the recipe given, calculate the percentage of sugar in the product. What is the sugar substitution so that a classmate with diabetes can also eat the 'house'? How would the price of the product change?

f) If there are 5 pupils in a group, how many opportunities do the pupils have to distribute their responsibilities? Draw a tree of possibilities. And then calculate using the combinatorial multiplication rule.

g) One group consists of 4 girls and 1 boy. What is the chance that he will be the photographer of the group?

BUSINESS PLANS:

Calculate the cost of the product.

Record the readings of the water and electricity meters at the start of the cooking process and do the same at the end of the process.

Check the cost of a cubic meter of water and the cost of a kilowatt-hour of electricity.

Calculate the cost of water and electricity.

Check on the internet how much such baked goods cost during the Christmas period.

Estimate the time taken.

Think how much you would like to earn per hour.

Calculate whether you would be able to sell the 'houses' at a profit?

Is it worth setting up such a business?

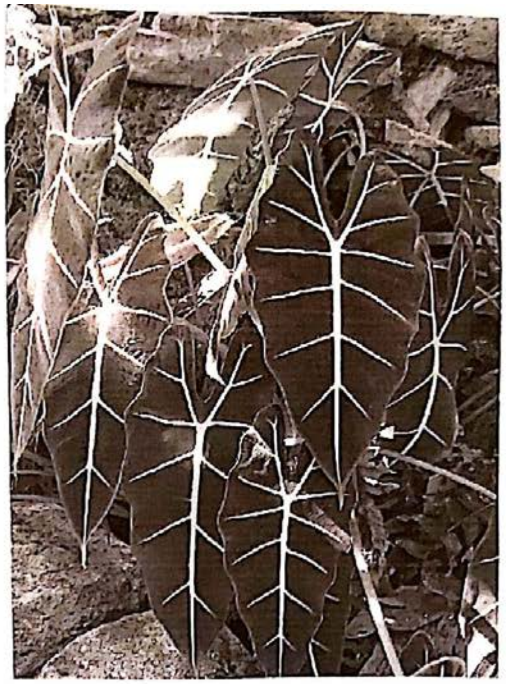
Topic	**Geometry in plants**
Teacher of Mathematics	Jovita Vainauskienė
Teaching subjects	Mathematics, biology, computer science.
Duration	2-3 lessons
Adopted for	9 Grade
Aims and objectives:	Learn about the plants growing in the school grounds. Learn to identify plants by their inflorescence, leaves and smell. Using the formulas learnt in mathematics lessons, calculate the area and perimeter of a leaf by drawing it in a drawing book.
Competences	Cognitive, healthy living, creativity.
Students' evaluation	Students are evaluated on their calculations, group work and presentation.

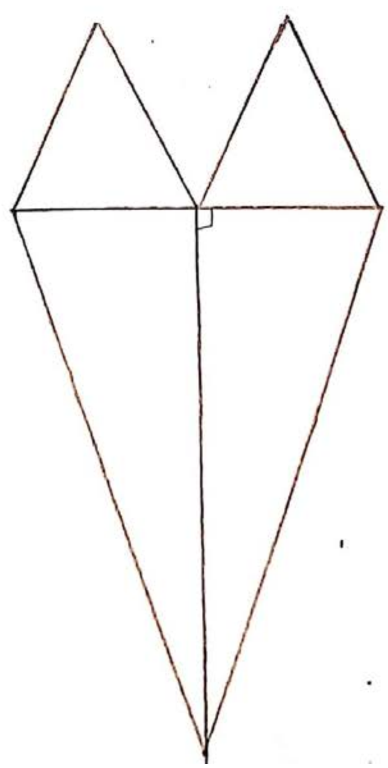
Instructions: Pupils work in pairs using the PlantNet app to find which plants are growing in the rock garden, the flower garden, and the spice beds in the school grounds. They fill in the data in tables:

Type	Latin name	Spice	Pharmaceutical	Perennial/annual	Fragrant	Useful features

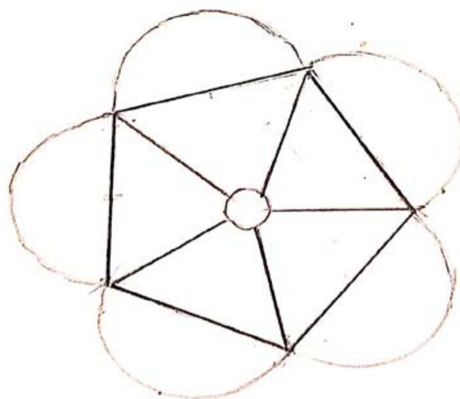
Demonstrate to students that trees and plants are all made up of geometric shapes. Suggest that, after choosing a plant, they draw it on a piece of paper, break it down into geometric shapes and calculate the perimeter and area of that plant. The aim is to review the properties and formulae of indented and definite polygons.

1. Measure the sides of the triangle, calculate the area and perimeter. Write your answer to the nearest 1mm





2. Measure the length of the side of the pentagon and calculate its perimeter and area.



Choose a plant that fascinates you and, based on the examples provided, draw it on the sheet, then break it down into geometric figures and count their perimeters and areas.

Tell what group, section and class the plant belongs to, what its characteristics are, and what the leaf veins are.

	Press ban in Lithuania 1864-1904
Teacher of Mathematics	Jovita Vainauskienė
Teaching subjects	History, physics, mathematics, geography, computer science.
Duration	2-3 lessons
Adapted for	9 Grade
Aims and objectives:	Learn about the period of the press ban in Lithuania. - Find out why it was important to preserve Lithuanian writing. - To find out how the Lithuanian press was transported in Lithuania. - Learn about the most famous Lithuanian book carriers. - Repeat the standard expression of a number and learn how to perform operations with numbers written in standard expression. - Repeat the concept of scale and calculations and calculate how long it took to travel from one city to another. - Repeat the rules for calculating percentages Learn about other systems of measurement (not just Si)
Process	1.Students are told about the period of the press ban in Lithuania (history of Lithuania is repeated) 2. Students are divided into groups of 4-5 and use a map to calculate the distances to the indicated cities. 3. Using an internet search, students find the biographies of the most famous book carriers and present the biography of the most memorable one in class. 4.They complete Tasks 1;2;3. 5.Using paint program, draw a picture on the topic “Bookbinding in Lithuania"
Student assessment	Students are evaluated on their drawing and group work and presentation.

The Process

Bookbinding is a Lithuanian cultural phenomenon against the ban on the Lithuanian press and Latin scripts by Tsarist Russia in 1864-1904. For 40 years, book carriers secretly transported the Lithuanian press to Lithuania from Prussia and Lithuania Minor and distributed it throughout the country, risking their freedom and even their lives. Despite the fact that the punishment for distributing books was imprisonment or deportation to Siberia, the book traffic was very active. Lithuanian books and newspapers passed from hand to hand, were read in secret, and children were taught Lithuanian writing at home. Precisely because the forbidden and hard-to-get fruit is so sweet, the ban on the Lithuanian press had the opposite effect: it brought out a generation eager for science, imbued with Lithuanian consciousness, and awakened the need of ordinary people to read and speak their mother tongue. In 1904, the imperial authorities, seeing that they could no longer stop the distribution of books, lifted the ban on the Lithuanian press, which had lasted for more than 40 years. In 2004, UNESCO recognized bookbinding as a unique and unparalleled activity in the world, and 16 March was declared book carrier Day. It is the birthday of the most famous book bearer Jurgis Bielinis.

Printing ban - the Czarist government's ban on printing, importing from abroad and distributing Lithuanian publications in Latin letters in Lithuania and in the European part of the Russian Empire. It was in force in 1864-1904.

The press ban was also directed against the Lithuanian nation, its economy, social development, culture, and national existence.

After the approval of the rules for the management of schools in the Vilnius Educational District on 4 April 1863, all public and non-state parish schools, which until then had often taught in Lithuanian, were closed.

According to the school reform of the Muravyov era, elementaries and prayer books were only allowed to be used in Russian characters.

On 17 June 1864, by order of Mikhail Muravyov, the Governor-General of Vilnius, the printing of elementaries in Latin letters was banned, and later all Lithuanian publications.

On 18 September 1865, Governor-General Konstantinas Kaufmann, who succeeded Muravjov, by a secret circular of 18 September 1865, legalized the ban on the printing press, suspended the distribution of all previously published Lithuanian books in printers and bookshops, and forbade the importation of Lithuanian publications from abroad. On 5 October 1865, on Kaufman's proposal, the Russian Minister of the Internal Affairs, Pyotr Valuyev, issued a decree banning Lithuanian printing in Latin letters in the European part of the Russian Empire.

On 2 January 1873, the importation from abroad and the distribution of the Lithuanian press in Gothic letters were banned.

Only in 1880 did the Russian Academy of Sciences grant permission to print some scientific works in Lithuanian in Latin letters, but they could not be distributed in Lithuania.

Resistance to the ban on the printing press fostered anti-war sentiments, promoted the struggle for national liberation and the unity of the nation.

The Lithuanian press, expelled from Vilnius, started to be published in towns in Lithuania Minor, concentrated in the Panevėžys district, Garšviai city (present-day Griežionys).

Task 1:

Using the given map, the pupils measure the distances from Panevėžys to Tilžės, Ragainiai, Kaunas, Pagėgiai, Aluška, Mintauja, Virbalis, Smalininkai.(1CM :27KM)

Answers should be given in : a) 1km, b) centimeters written in standard expression;

Task 2:

Books were transported on foot or by horse-drawn cart. They travelled empty to the place where the books were picked up and returned with a load. Knowing that the average speed of a person (weighing 80kg) on foot is 5km/h and that of a horse pulling a cart is 16km/h.

a) Using the formula $v_2 = \frac{m_1 \cdot v_1}{m_1+m_2}$, , where m1 is the weight of the carrier, m2 is the weight of the books, and v2 is the speed of the man with the books, calculate the speed of the man with the two packs.

(b) Using the formula$v_2 = \frac{m_1 \cdot v_1}{m_1 + m_2}$, where m1 is the weight of the horse, m2 is the weight of the books + the weight of the person in the cart; v2 is the speed, calculate the speed at which the horse will be moving if it is pulling a cart full of 20 pots of books. (The average weight of the horse is 600kg and the carriage weighs 200kg)

c)Calculate how many hours it took the book carrier to travel to and from these cities on foot and with the horse pulling the cart. Convert the results to m/s.

Task 3.

Using Wikipedia, read the biographies of the most famous book carriers and their places of deportation.

According to historical data, people were transported out of Lithuania in 24 echelons. Most of the exiles - 25161 people (78%) were placed in Irkutsk region.

a) If the average number of people in a family is -4, how many families were expelled from Lithuania?

b) People were transported in cattle wagons. From Marijampolė, where the book carrier Juozas Akelaitis lived, to Kačiugoyra 6500km. Knowing that the speed of the train at that time was about 18km/h, calculate how many days this journey took.

c) After the deportees were disembarked from the train, they were transported another 250km by boat and had to walk for about 7 hours to the village where they lived.

The speed of large container ships is 24-30 knots. A knot is a unit of speed equal to one nautical mile per hour - 1,852km/h.

1.Calculate how long it took to get to Kaciugoyra.

2.Calculate how long the journey would have taken if Juozas Akelaitis had decided to walk back to his homeland?

Topic	**Snail**
Teacher of Mathematics	Jovita Vainauskienė
Teaching subjects	Mathematics, physics, biology, computer science.
Duration	2-3 lessons
Adapted for	9 Grade
Aims and objectives:	To learn about invertebrates, the process of scientific enquiry and a scientific approach to wildlife. Learn to apply their knowledge of mathematics and statistics to educational research and calculations.
Process	1. During the first lesson, the students, accompanied by their biology teacher, go in search of snails. The teacher explains the structure of the snail, reproduction, feeding and the snail's place in the food chain. The students search for snails and discuss what species they have found. They come up with names for the snails. They list the parts of a snail's body, measure the height of the snail's shell, the length of its leg, weigh. Record the data in frequency tables. 2.Organise a snail race. Using a stopwatch, time the movement, measure the distance. Calculates the speed of each snail and compares it with the Guinness World Record. The gastropod mollusks games are held on a table covered with a wet tablecloth. The snails are placed in the middle ring and the first snail to reach the outer circle is declared the winner. The snail race begins when "ready, steady, slow" is called. The current Guinness World Record was set in 1995 when a snail named Archie covered 33 cm in two minutes and 20 seconds. The snails are preceded by a lettuce leaf, an apple, a slice of courgette, a biscuit, and a piece of meat. Observe what the snails first snack on. Discuss the diet of the snails and their place in the food chain. The snails are safely released back into their home territories. 3. On their return, the students calculate the sample mode, mean, median, make tables of frequencies, relative frequencies and draw graphs. Discuss the population and diversity of snails along the river. Find out which species of snails live in Lithuania. Gives examples of other invertebrates. 4.Process the data using excel and present the results in class using PowerPoint.
Students' evaluation	Students are assessed on their calculations, group work and presentation.

Table of the survey

Snail's name	Type of species	Snail shell type	Leg length	Weight	Speed cm/min	Speed km/h

1. A little snail climbed up a bent to see what her beloved meadow looked like from above, but the bent bent into the shape of a parabola corresponding to the function (1pc corresponds to 1dm) y=7x-3.5x2, all the way to the ground. Calculate the height of the cone at its highest point and the maximum distance reached by the top of the cone.

2. Distance from the meadow to the forest is 21 meters. A snail crawls 4 meters towards the forest in one hour, but returns 2 meters back in the next hour. How many hours will it take for the snail to reach the forest if it moves in a straight line and does not rest?

3. An adult snail lays eggs every 3 months which hatch into 100-150 snails. How many snails will be born in 2 years if we keep 4 snails?

4.Snails are a very valuable source of protein and are easily absorbed by the human body. As many as 9 of the 10 essential amino acids are found in snail meat. About 150 grams of snails are known to contain as much protein as a kilogram of beef.

The recipe for 4 people includes: 80 pieces of cleaned snail legs, 2 carrots, 2 celery leaves, 4 onions, 4 cloves of garlic, 2 tablespoons of tomato sauce, 100 g butter, grated Parmesan cheese, salt and pepper. How many snails and butter will be needed to feed 10 people?

Topic	A JOURNEY THROUGH THE SOLAR SYSTEM
Teacher of Mathematics	Jovita Vainauskienė
Teaching subjects	Mathematics, physics, astronomy, music.
Duration	1-2 lessons
Adapted for	10 Grade
Aims and objectives:	Learn about the solar system and its cosmic bodies. Use https://stellarium.org/ to find constellations in the sky. Repeat and apply the formulae for the length of a circle, the area of a circle, the surface area of a sphere and the volume of a sphere, learned in geometry, to solve problems about the bodies of the solar system.
Competences	Cognitive, scientific, general mathematical skills.
Students' evaluation	Students are evaluated on the correct completion of tasks, activity in class, homework, and the presentation of their zodiac star sign.

Process: we often look up at the sky, but rarely think about the cosmic bodies that orbit above us. This lesson is about the planets of the solar system, their position in the Universe, the latest space developments, and the impact of cosmic bodies on human destiny. The lesson includes meditative music "Cosmic Energy from the Universe". The pupils are divided into 4 groups according to their date of birth (Group I: January, February, March; Group II: April, May, June; Group III: July, August, September; Group IV: October, November, December) and write down on a piece of paper all the formulae they know related to the circle, the circle, the sphere, the sphere, the ball, the velocity of light, the refraction of the ray, the basic laws of physics.

...Now let's close our eyes and travel around the Solar System. The teacher briefly talks about the solar system, its satellites, comets and asteroids.
The planets of the solar system:

Object	Average distance from the Sun (million km)	Diameter(km)	Period of rotation about the axis	Orbital period	Number of satellites
SUN	-	1392530	25d.	-	8 planet
Mercurius	57,9	4878	58,65d.	88d.	0
Venus	108,19	12102	243d.	224,70d.	0
Earth planet	149,597	12756(equator)	23h56min4s	365,25d.	1
Mars	227,94	6794,4	24h37min23s	686,96d.	2

Jupiter	778,38	142796(equator)	9h51min	11,86m.	16
Saturn	1427	120660(equator)	10h14min	29,46m.	17
Uranus	2870	50800	23h54min	84,01m.	15
Neptune	4509	48600	17h50min	164,8m.	8
Moon	384000km from the Earth	3476	27,32d.	-	-

Tasks for group work.

Each group takes two planets in turn and counts them according to the table provided:

1. How far do they travel before they revolve around the sun? (2 points)

2. What is the area of their equator? (2 points)

3. If you wanted to give a planet to a loved one, what size and volume of gift box would you need? (4 points)

4. If you wanted to make the largest possible model of a planet out of a wooden cube, what percentage would be waste wood? (2 points)

5. The diameter of the nucleus of an atom is approximately equal to 1-10-12cm. How many times the diameter of your pallet is greater than the diameter of the atom. Write your answer in standard expression. (2points)

6. (Physics state exam task). The Sun, reflected from the calm surface of the water, can be viewed without squinting even at noon. However, in the morning and evening this reflection is blindingly bright. Why? (1 point)

A: The Sun is closer to Earth.

B: Reflection is altered by the movement of the water surface.

C: The smaller the angle of incidence of light rays, the greater the proportion of light that is reflected,

D: The greater the angle of incidence of the rays of light, the greater the proportion of light reflected.

7.Two observers are trying to estimate the height of the Sun above the horizon at the same time without instruments. One of them is diving underwater in Lake Sartai and the other is observing the Sun from the shore. Does the Sun look the same to them? (1point)

A The diving observer Sun looks higher.

B The Sun looks lower to the diving observer.

C For both observers, the Sun looks the same height.

D The diving observer cannot see the Sun.

8. (Physics exam task) We can see only one side of the Moon from Earth because: (1 point)

A The Moon is stationary relative to the Earth.

B The Moon rotates around the Earth without rotating on its axis.

C The Moon revolves around the Earth in 24 hours.

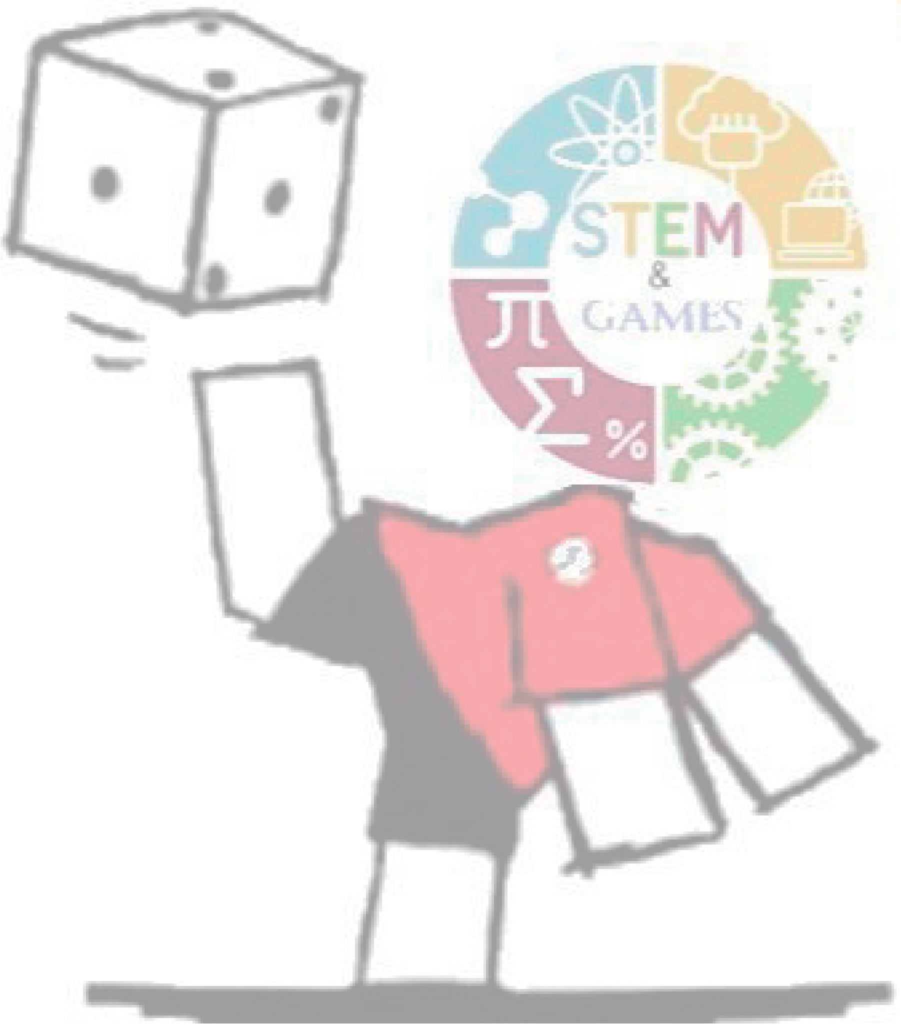
D The Moon revolves around the Earth and on its axis in the same period.

9. What music do you listen to when you want to relax?

After completing the tasks, the students present them to the teacher. The teacher assesses the number of tasks completed plus the number of formulas written correctly. They turn on the Stellarium app (https://stellarium.org/) on their mobile phone and look up at the sky to find the constellations of the zodiac signs of their group mates. They draw them on a piece of paper. They write down the biggest stars. They think about whether the alignment of the stars can influence a person's destiny.

Homework: Based on the table, think of as many questions as possible and answer them. Find some interesting or unbelievable facts about the planets. (The homework will be marked by the teacher , the other groups will score from 1 to 10 and take an average. This will be added to the teacher's assessment and converted into a grade)

Such a lesson should certainly make you look up at the sky on a starry night. Find Mars, Venus, the Greater and Lesser circles, the North Star, the constellation of your horoscope sign, or maybe you'll be lucky enough to see a shooting star and make a wish.



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