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Connect SUPPORT ONLINE EDUCATION

Upskilling of schools' teachers to effectively support online education

Final Teacher's Guide

University of Cyprus

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Final Teacher's Guide

The Final Teacher's guide (FTG) is a powerful tool for educators to implement the CONNECT approach. It summarizes the cardinal methods included in the CONNECT approach, indicating ways to implement them. Lessons learned from piloting along with practical guidelines stand out in the Teacher's Guide.

Teachers are urged to read the Final Teacher's Guide, reflecting on their teaching while studying the material uploaded to the project's website. This will help them to better realize the added value of this intellectual outcome, and this will also whet their appetite for implementing the CONNECT approach at their Schools.

The Final Teacher's Guide has been developed under the auspices of the University of Cyprus with the contribution of all partners as the IO4 Intellectual Outcome of the CONNECT project.

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1 CONNECT project overview

The COVID-19 pandemic brought about radical changes in the entire educational foundation. The "shutting down" of schools indicated the potential of distance education. In the face of the COVID-19 pandemic, modern educational practices were employed, compensating for face-to-face instruction.

The way was paved for practices combining face-to-face instruction with contemporary teaching methods. In this context, Blended Learning became the prevalent educational approach. It is important to underline that important European Initiatives revolve around up-to-date educational practices. In this spirit, the CONNECT approach embraces new educational opportunities stressing the importance of Blended Learning and Flipped Classroom.

The CONNECT project is a joint venture which serves the purpose of upskilling educators to implement up-to-date practices such as Blended Learning and Flipped Classroom. The CONNECT potential lies in the fact that European partners learned to collaborate to the same end. They learned to overcome difficulties, deal with problems, and work the same way to culminate the project. Partners from Greece (Regional Directorate for Primary and Secondary Education of Attica-RDPSEA, Hellenic National Agency and Institute of Computer Technology and Press-CTI Diophantus), partners from Italy (National Research Council-CNR), and partners from Cyprus (University of Cyprus) worked together, shoulder to shoulder and achieved milestones.

The term "upskilling" denotes that the CONNECT project does not only aim at helping educators develop basic digital skills but also aspires to help educators develop high-level skills in a way to upskill them. The educators' upskilling is achieved through valuable intellectual outcomes.

Each intellectual outcome is developed to achieve inclusion and to promote active learning. Given that Flipped Classroom fosters active learning, the Flipped Classroom Model assumes a fundamental role in the CONNECT approach. Inclusion is achieved in the sense that the intellectual outcomes developed in the context of the CONNECT approach are widely available and they are tailored to the needs of the potential learners. Learners are viewed as active participants and everything that the CONNECT approach encompasses (methods, teaching material, etc.) is adjusted to their needs.

The respective intellectual outcomes aspire to create real learning opportunities for all learners. The training session included in the CONNECT approach is also governed by the same principles. It should be stressed that all intellectual outcomes meet specific quality standards. Image 1 depicts the intellectual outcomes and the key-note processes included in the CONNECT approach.

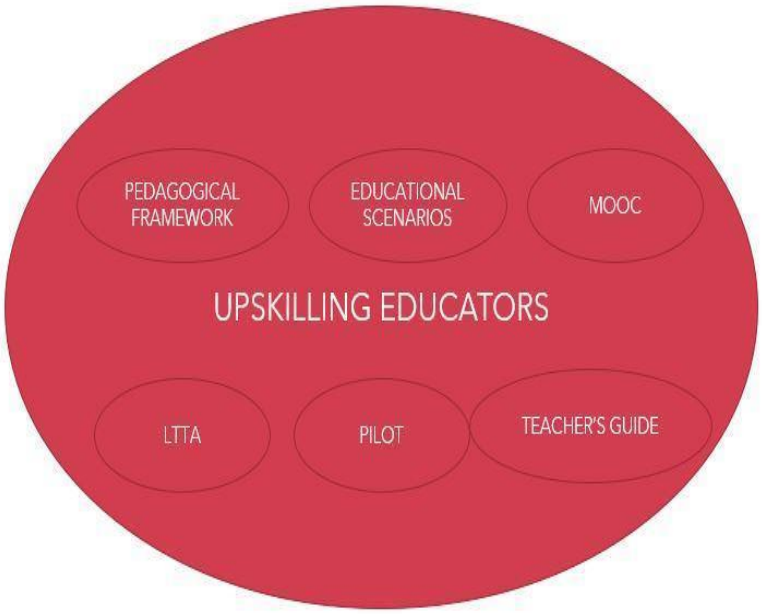

Figure 1. Intellectual Outcomes and key-note Processes

1.1 Summarizing IO1 and IO2 outcomes

1.1.1 IO1 Outcome

IO1 aimed to develop a pedagogical framework underpinning the online delivery of courses in secondary schools in addition to the in-class activities (blended learning). Moreover, it aimed to survey the landscape regarding the delivery of online education in EU schools during the COVID-19 pandemic aiming to define the methodologies used, the digital tools used, the challenges and problems raised from a pedagogical and technological point of view, and the mitigation steps taken (if any).

The main innovation of this IO lies in the holistic process adopted for the design of the pedagogical framework. More specifically, to accommodate the actors and the complexity

of the target environment, a multi-ontological perspective will be employed to iteratively develop and refine the pedagogical framework.

This multi-ontological perspective included the following parameters: (a) secondary school setting among the participating countries (GR, CY, IT), (b) curricular constraints, (c) psychology, cognition & behavior of secondary schools students, and (d) the different profile of teachers (i.e. those coming from STEM fields vs those coming from Human Sciences). Moreover, the pedagogical framework is aligned with engagement and content, as well as with the naturalistic context of teaching with the target age group by taking a multi-actor approach to pedagogical design. The main target groups of this IO will be teachers of secondary schools. The high transferability of this IO is ensured by the design of the pedagogical framework considering the different school settings among EU countries. The work that will be conducted under IO1 includes the following:

1.1.1.1 The European school educational landscape during the COVID-19 crisis.

This activity carried out research on the digital tools used in EU schools for digital learning, especially during the period of the COVID-19 crisis. It will also collect the main challenges faced and the problems raised. The survey will be conducted based on Internet research and an online survey with at least 120 stakeholders (30 from each country – GR, IT, and CY). These stakeholders will be teachers of secondary schools, directors of secondary schools, and regional educational authorities. In addition, at least three interviews (online or face-to-face) with directors of secondary schools will be performed in each country (12, in total). The knowledge gathered in IO1 will serve as a setpoint/evidence base for the next project IOs and actions.

1.1.1.2 Design of a pedagogical framework

This activity dealt with the design of the pedagogical framework underpinning the online delivery of courses in secondary schools in addition to the in-class activities. This framework defined the main principles of the philosophy of online learning and teaching. It outlined the different learning and assessment strategies that can be adopted during online education considering the schools' settings, the curricular constraints, the psychology, cognition, and behavior of students, as well as the profile of teachers. Focus groups with the participation of project partners as well as associated partners and other stakeholders were utilized. This activity provided the framework for the design of the educational scenarios under IO2.

The IO1 deliverables are available at the link

1.1.2 IO2 Outcome

The main part of the IO2 Outcome was the creation of educational scenarios to support teachers to efficiently deliver online courses and especially courses in the fields of

Mathematics, Physics, and Language as complementary to in-class instruction.

The term teaching scenario, (teaching situation) refers to the comprehensive, detailed, and structured description of a teaching process, which focuses on one or more subjects having specific educational goals, and is based on specific teaching and pedagogical principles. The teaching scenario or educational scenario usually lasts for more than one teaching hour. One or more digital tools may be used in the teaching scenario, but the use of technology must be considered, not simply as an innovation, but as a necessity, which gives the learning process additional didactic and pedagogical value.

The scenarios in the "CONNECT" program were developed in three phases. In the first phase, through distance teaching and learning, the students contact with the knowledge. In the second phase, during face-to-face teaching, the students, using the knowledge they have acquired in the first phase, engage in activities that will help them understand and consolidate the new knowledge. The third phase was implemented by distance learning and may encompass teaching evaluation, students' self-evaluation, assessment, and feedback.

Several scenarios have been developed for Mathematics, Physics, and Foreign Languages.

The Mathematics Curriculum is still considered to result in theoretical knowledge, taught by traditional teaching, even though many attempts have been made to prove otherwise. Students feel that they must learn abstract definitions by heart and that they have to be able to prove theorems and work on complicated exercises that have nothing to do with everyday life. If the students' anxiety and phobia about Mathematics are added, we end up with students who do not understand the lesson content and, as a result, they dislike it. However, when it comes to Mathematics education, "our goal is to strengthen the logical-mathematical aspect of students' thinking and its expression as an integral part of our culture and civilization" as stated in the material for the training of teachers at the Training Support Centers for the teaching of Mathematics (Training of Teachers in the Use and Utilization of ICT in the Teaching Process, Patras, May 2008, in Greek).

Therefore, there is a need to design and create mathematical environments characterized by dialogue, experimentation, discoveries, multiple representations of concepts, and students' active participation to acquire knowledge. The design of a teaching scenario for Mathematics is a real challenge for a teacher, since he/she must integrate the design of the lesson, the pedagogical and teaching principles on which it is based, but also document the use of technology to serve the intended learning outcomes.

In the European Program "CONNECT", a total number of nine teaching scenarios for Junior High School was designed for the subject of Mathematics. Three cooperating countries, i.e. Greece, Italy, and Cyprus participated in the program.

1.1.2.1 MATHEMATICS SCENARIOS

The nine scenarios were designed to be implemented with Blended Learning using the Flipped Classroom methodology in the framework of the "before", "during" and "after" methods. The teacher, considering the pre-existing knowledge of his/her students and their interests, plans his/her teaching so that the students acquire knowledge, while at the same time developing soft skills such as cooperation in groups, creative and critical thinking, problem-solving inquiry, decision-making, communication skills, and digital skills. Blended Learning is a new experience for students because it combines the advantages of face-to-face and distance learning with the use of the Internet. The scenarios designed for Mathematics aim to function as teaching suggestions, but also as a starting point for teachers to design their scenarios that will meet the needs of their classes. They can also be used as issues for discussion and reflection to upgrade the teaching of Mathematics. The organization of the class is an important factor in the success of the implementation of the scenario. Worksheets (W) and Assessment Sheets (A) have been developed for the scenarios in addition to using digital material such as Google Classroom virtual classes, Videos (V), Virtual Labs (VL), Internet links (L), digital Concept Maps (CM), images (I) and Google Forms questionnaires.

MATHEMATICS SCENARIOS (CYPRUS)

1. Teaching of First-degree Inequality
2. Teaching Pythagorean Theorem
3. Teaching of Triangle-Sum Types of Triangle Angles

MATHEMATICS SCENARIOS (GREECE)

1. Teaching the identity $(a+b)^2=a^2+2ab+b^2$
2. The Linear System of two equations with two unknowns and its Graphical solution
3. Linear inequalities in everyday life

MATHEMATICS SCENARIOS (ITALY)

1. Surface area of a cylinder
2. Pythagorean theorem
3. Introduction to polynomial

1.1.2.2 PHYSICS SCENARIOS

The physics scenarios were designed on the principles of Blended Learning and Flipped

Classrooms. In addition, physical laboratory instruments and everyday materials were used, with which students had the opportunity to acquire laboratory skills.

PHYSICS SCENARIOS (CYPRUS)

1. Derived quantities of mechanics (surface area, volume, density), their measurements, and measuring instruments.
2. Measurements-Fundamental Quantities of Mechanics
3. Rectilinear Smooth Motion

PHYSICS SCENARIOS (GREECE)

1. Electric Dipoles – Ohm's Law
2. Electric Circuits, resistor wiring
3. Refraction

PHYSICS SCENARIOS (ITALY)

1. Volcanoes
2. Introduction to Electricity
3. Energy and Sustainability

1.1.2.3 ENGLISH SCENARIOS

The CONNECT educational Scenarios for English are focused on topics, which are either linked to the high school curriculum or are connected to the interests and needs of the students. In any case, they are interdisciplinary and focus on phenomena of the English language and/or a combination of vocabulary and grammar concepts with close links to everyday life and/or students' concerns and interests.

ENGLISH SCENARIOS (CYPRUS)

1. Camping
2. Superstitions
3. Phobias

ENGLISH SCENARIOS (GREECE)

1. To connect or not to connect
2. Graffiti & Street art

ENGLISH SCENARIOS (ITALY)

1. Sports, hobbies, and Leisure

2. Present a Perfect Presentation
3. Summer plans

1.1.2.4 FRENCH SCENARIOS

One French Scenario has been developed for the French Language by Greece:

1. Homeschooling

The CONNECT educational scenarios are available at the link

Another important component of the IO2 Outcome was the "Instructions for Developing Educational Scenarios' which includes:

- A brief overview of the "Connect" Educational Scenarios.
- Instructions for the development of an Educational Scenario.
- A presentation of the structure of an Educational Scenario.

The instructions are also available at the below link

In parallel, other important components of the IO2 Outcome are:

- A template of Educational Scenarios.
- Evaluation Criteria

These deliverables are also available at the link

It is important to underline that the scenarios of each country are aligned with the respective curriculum. In this sense, specific differences could be spotted among the scenarios. For instance, the curriculum of Physics in Italy is oriented toward Generic Science and not Pure Physics. Therefore, the topics included in Italian scenarios are drawn from Generic Science.

1.2 Presenting CONNECT online courses.

IO3 deals with online course design. The online courses are asynchronous, and their topic is defined based on the main findings derived from the survey conducted under IO1 and thus the training needs of teachers. Furthermore, the design of the online courses follows a holistic approach covering both topics concerning the effective exploitation of digital pedagogies as well as digital tools. This is essential as it has been observed that teachers of STEM-related courses (i.e., Mathematics and Physics) commonly lack pedagogical skills. In contrast, teachers of human sciences-related courses (i.e., Language) commonly lack

digital skills for online courses.

The MOOC courses are designed based on the following principles:

- **Inclusion:** inclusive practices are viewed in terms of different types and ranges of achievement, different gender, as well as different learner's educational background.
- **Learner engagement:** learners are engaged and motivated, and activities have a worthwhile educational aim, not just to occupy the learners, be enjoyable le, and not to produce adverse emotional reactions, improving the learning atmosphere.
- **Effective learning:** promoting learner autonomy; encouraging metacognitive thinking and collaboration, providing authentic learning exhibiting multiple perspectives on a topic.
- **Coherence**, consistency, and transparency: objectives, content, activities, and assessment should match each other. It should be clear to the user what to expect.
- **Ease of use:** being open and accessible, intuitive, and not requiring guidance on use, providing appropriate guidance to learners.

The online courses aim to empower teachers to transform their lessons by integrating the CONNECT approach in their everyday classrooms and will also give access to open educational resources. All courses are available in English, Greek, and Italian. For instance, Course 4 explains how to develop an educational scenario, presenting specific educational scenarios in the previous didactic objects.

The MOOC courses revolve around the below topics:

1. A pedagogical framework that encompasses cardinal up-to-date methods.
2. The importance of Flipped Classroom and Blended Learning.
3. The development of educational scenarios.
4. Online Student Assessment.
5. Incorporating Digital tools in daily teaching.
6. Digital Safety

MOOCs training leads to certification on the condition that the activities of all courses have been completed. Image 1.2.1. provides an overview of some of the MOOC courses. MOOC courses are still open to your avail. All MOOC courses are available here

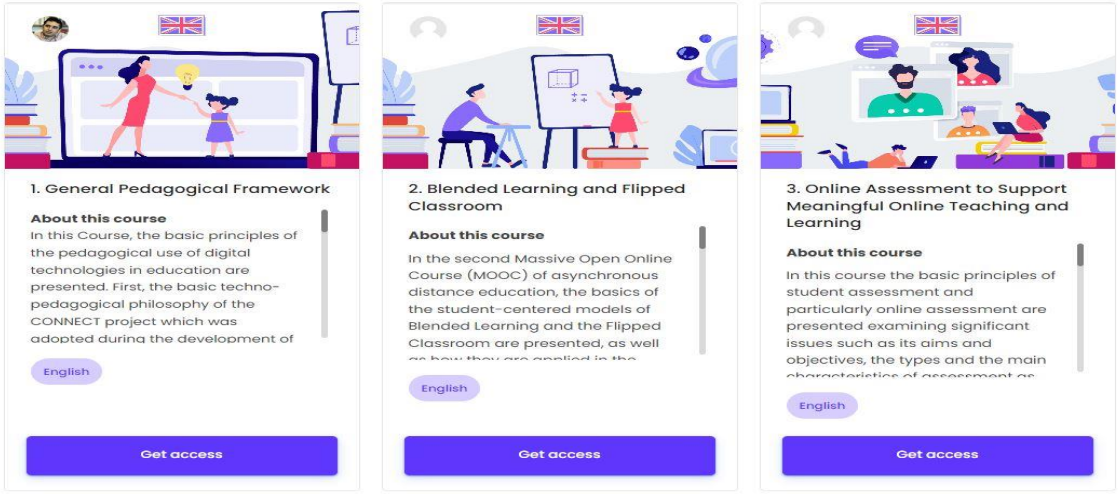

Figure 2.Overview of some of the MOOC courses

1.3 Intellectual Output 4 - Objectives & Activities

The overall objective of Intellectual Output 4 is to develop a comprehensive guide to secondary school teachers for the online delivery of courses (Mathematics, Physics, and Foreign Language) in addition to the in-class activities based on the CONNECT approach. Secondary school teachers are addressed through properly designed processes to fully understand the pedagogical framework of the project.

The Teachers' Guide is innovative, including the appropriate "Connect Approach" Handbook material, and other useful tools and resources. The impact expected is two-fold: On the one hand, it is expected that teachers will fully understand the program's needs and objectives and increase their knowledge and skills. On the other hand, improved experience through the pilots is expected to result in more confident teachers, as well as more active leading to an overall improvement of the whole training process and education experience. The teacher's guide will be easily used in other countries where similar training needs in secondary schools exist, thus

transferability is high. The Final Teachers' Guide aims to support teachers in efficiently using the CONNECT approach. It integrates best practices defined during project implementation and how they can be exploited in online education among students and teachers. It collects easy-to-follow document resources, teaching materials, methodologies, and sample educational scenarios.

The guide is produced in English and its short version will be translated into EL, and IT. The Teachers' Guide is accomplished through the following phases:

- Preliminary Teacher's Guide
- MOOC Training and LTTA Activity
- Pilot Implementation in school practice
- Evaluation of pilots
- Final Teacher's Guide

It is also important to underline that the Preliminary Teacher's Guide is also available on the project's website.

1.4 Exploitation of CONNECT approach.

Through this intellectual output, the CONNECT consortium will further explore issues related to project sustainability, exploitation, and transferability of its results. This output will develop an exploitation plan that will present preconditions and recommendations for the adoption of the main outputs, after the project end. The target groups of this guide policymakers in school education, local and regional school authorities, secondary schools, as well as schools of initial vocational training.

1. Communication and contacts with stakeholders about the exploitation of IO1, IO2, IO3, IO4

All partners will identify and conduct stakeholders or multipliers in their countries to explore the preconditions for the exploitation of the project products. Contacts will be made in person or via telephone, or video calls, following the pattern of a structured interview. A total number of six (6) stakeholders should be reached in each country through this activity. Stakeholders invited will be local and regional school authorities, secondary schools, schools of initial vocational training, and higher education institutes.

2. Exploitation plan / Sustainability

This activity deals with the exploitation plan of the CONNECT project. It will formulate a detailed exploitation framework on how the CONNECT outcomes can be exploited by schools at the partners' national and European levels. The exploitation plan will include (a) identification of stakeholders at local, regional, national, and EU levels and (b) identification of forums and/or events for reaching effectively potential users and other stakeholders.

Additionally, the exploitation plan aims to (a) Mainstreaming –which means the results of the project come to the attention of stakeholders at the local, national, regional, and international levels, and (b) multiplication –which means the consortium tries to convince end-users. The IO5 deliverables are available at the link

2 Focusing on the “Connect” up-to-date Educational Practices

The Erasmus+ CONNECT project fosters “the inverted learning with an emphasis on hybrid model” (CONNECT, 2021) aiming at reinforcing the ability of partner country education and training institutions to provide high-quality inclusive digital education.

The pedagogical approach is, thus, expected, to provide opportunities for personal, socio-educational, and professional development of the target groups involved; using innovative online resources and tools to leave no one behind” (European Commission, 2020c) will be exploited towards this direction.

As such, it is preferred in the proposed scenarios of the CONNECT project to exploit the principles of differentiation in combination with the methodology of the Flipped Classroom. As Joe Hirsch (Hirch, 2014), an initiator of the mixed learning teaching model he calls "Fliperentiation", argues, combining its two components (Inverted Classroom and Differentiated Teaching), this combination enables teachers to engage learners quickly and effectively in the appropriate learning activities for them, enriching their learning experiences and facilitating the learning process (Hirsch, 2014 refers to (Papadakis & Baxevanis, 2020, 206). According to the "Fliperentiation" learning model, the course is organized and conducted in three (3) Phases (p.p. 206-7) (Flipped Learning Global Initiative ,2018; Flipped Learning Network, 2013; Flipped Learning Network, 2014; Bergmann & Sams, 2012; Giannakos et al., 2014; Hewitt et al., 2014).

During Phase A, students are provided with diverse educational content (websites, texts, audio files, video files, photographs, etc.) for autonomous study which must be relevant to the planned individual or group experiential activities of Phase B which are carried out by the students in the classroom. Each learning planning is completed with Phase C' where the participants are provided with alternative activities evaluation, which can be carried out at home or school and evaluated formally or informally. Differentiation can be applied with the help of technology in any Phase of the model, enhancing the ability of choice which is a key feature of Differentiated Teaching. The scenarios that are formed within the framework of our program, are appropriately adapted to the above structural scheme, and are essentially built in two ways (Anderson et al., 2001):

A. Based on the choice of the objectives of educational practice: it is considered that differentiated teaching should initiate from a clear framework of objectives.

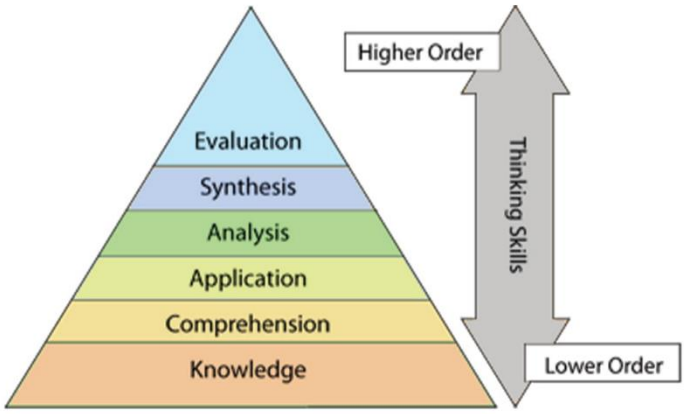

Figure 3. The target classification pyramid by Bloom

Bloom (1956, vol.1) has proposed the above escalation of objectives for the process by which the assimilation of the object that is the purpose of educational practice is attempted. We observe that in the evolution of this scale from the bottom to the top, the range decreases, which means that as the difficulty of the target increases, correspondingly the margins of tolerance in the estimation of its degree of fulfillment decrease.

B. Based on the content: The concept includes the basic information (vocabulary, phrases, syntax types, concepts, etc.) that the students must understand and the skills that the students should be able to demonstrate. The content is the "entrance" of the course. What is important in a diverse classroom is the ability of students to access various forms of content and at the same time the freedom to choose what they would be interested in studying.

The teacher should be careful to differentiate the content but not have different content. All of the above is considered in the proposals formulated within the framework of the CONNECT project. In the proposed scenarios of our program, students are grouped into small groups of 3-4 people, depending on their common needs, and they work as a team and the teacher guides each group separately, depending on the particular requirements

arising from the combination of the content of the lesson and its particularities. A wide variety of tools is also used, such as simulations, videos, and interactive applications, not **only as** alternative routes of educational intervention but also autonomously.

Thus, with the activities proposed and especially with their alternative variants that with appropriate interventions of the teacher can be adapted to the particularities of the specific group and educational context, the teacher has the opportunity: to start with the development of pupils' oral language skills, use a variety of visual and other materials taking into account the cultural and social context of the students, use stories in patterns to build new learning based on what students already know and provide students with authentic experiences such as presentations with speakers in the target language.

To sum up, differentiated pedagogy is not a specific method with a clear structure and predetermined rules, but an open pedagogical concept that meets with that of the interdisciplinary approach to knowledge and active learning (Papadakis & Baxevanis, 2020). It answers why and how enhancing each student's building knowledge is essential for school success. It is a tool that strengthens the knowledge and skills of each student and enables everyone to realize the specificity of their own approach and learning strategies. It is certain that its most cost-effective application certainly leads to the fullest development of the skills necessary in the modern world.

2.1 Issues Related to modern educational practices

The "closure" of schools has "opened" new perspectives on the use of digital tools per se as well as on their pedagogical use in the educational process. Considering that - during the first phase of the sudden schools' closure in the Spring of 2019 - the schools were forced into focusing mainly on digital tools, at the beginning of the school year 2020-2021, greater emphasis has been placed on the pedagogical use of the tools and how these can be effectively implemented as "good practices".

In other words, while the teachers' main concern was originally aiming at maintaining contact with students from a distance and sustaining interaction with the "community" members for psychological, emotional, social, and pedagogical reasons, during the second phase, several issues regarding pedagogy and didactics have emerged: management of school curricula subjects' content, teaching the most significant teaching modules, students' motivation for active engagement, assignments' delivery, assessment of

knowledge gained, and evaluation of the learning process in general (Unesco, 2020).

This has resulted in endless hours of training and learning, both formal and informal; practice communities have been developed within and outside schools, additional training courses have been initiated by institutions and informal school community groups have been established on social networks to exchange feedback on relevant practices.

Even educators who were not fond of digital tools, either because they were not familiar, with or trained or had doubts about the digital tools' effectiveness, had no alternative but to engage in this reflection process. Integration of technologies, mainly digital distance learning tools, has probably been the most "violent" change that the educational community has experienced in such a short period; it is a "bottom-up" change based on school practice, teachers' mutual support, in-school training, and peer solidarity. The transition from face-to-face to distance learning, though raising serious questions about the potential access of students to distance learning, has raised great expectations regarding its potential in the educational process. It is yet to be seen which distance learning processes are valid for years to come as well as the extent to which the latter will be integrated into "face-to-face" teaching. In addition, it is important to examine how digital tools will be used in favor of school community interaction "outside the walls" of the school.

2.2 Developing Educational Scenarios

The creation of the educational scenarios was to support teachers to efficiently deliver online courses and especially courses in the fields of Mathematics, Physics, and Language as complementary to in-class instruction. These scenarios constituted a structured plan, which described the educational process and aimed to guide teachers during this process.

They defined the form and the content of the teaching experience i.e., learning outcomes, pedagogical theories, orientation, etc., and provided the sequence of the learning activities and learning material during a specific learning process that takes place with the blended learning model. According to the learning objectives of each educational scenario, specific educational methods were utilized, which in turn determined the flow of activities, the appropriate tools, and the role of the teacher. The educational scenarios provided multiple means of action and expression, aiming to create opportunities for students to play an active role online by communicating their thinking through online discussion or taking the lead in facilitating an online educational activity. Within the

framework of the European Program Erasmus+ "CONNECT", and based on what is foreseen and agreed upon between the collaborating project partners, educational scenarios will be developed to promote digital education in high school as follow:

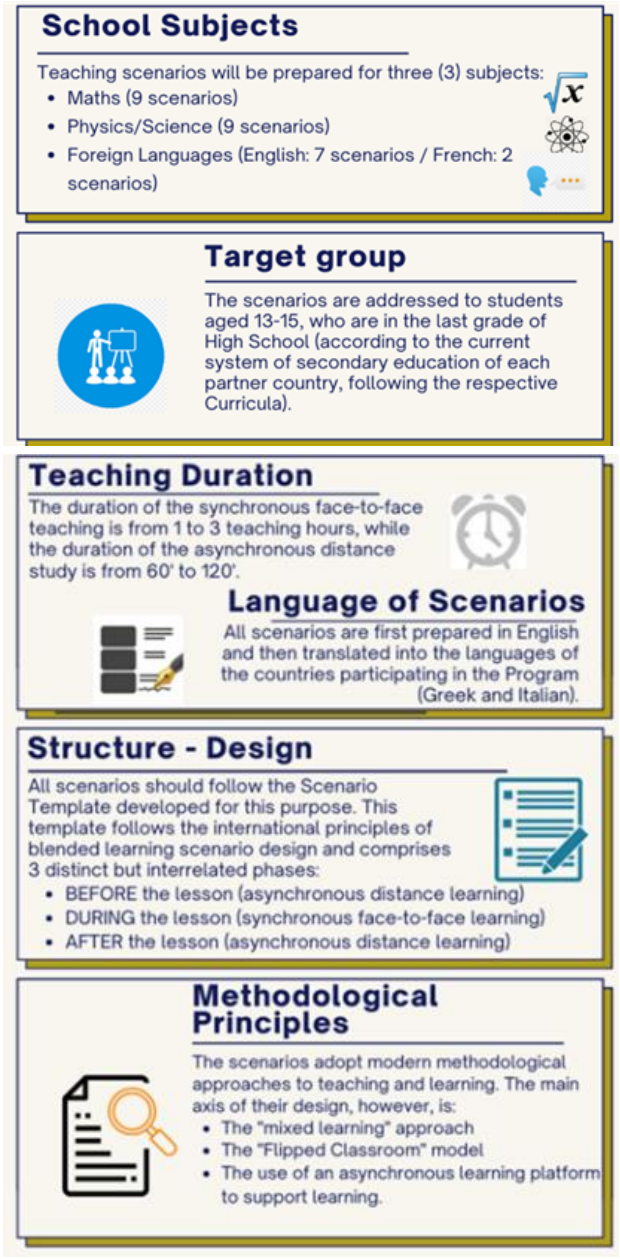

Figure 4.CONNECT approach

The steps for the development of a CONNECT Educational Scenario focusing on distance learning, as support to face-to-face teaching, through the exploitation of the “blended learning” and the “flipped classroom" approaches, are summarized below:

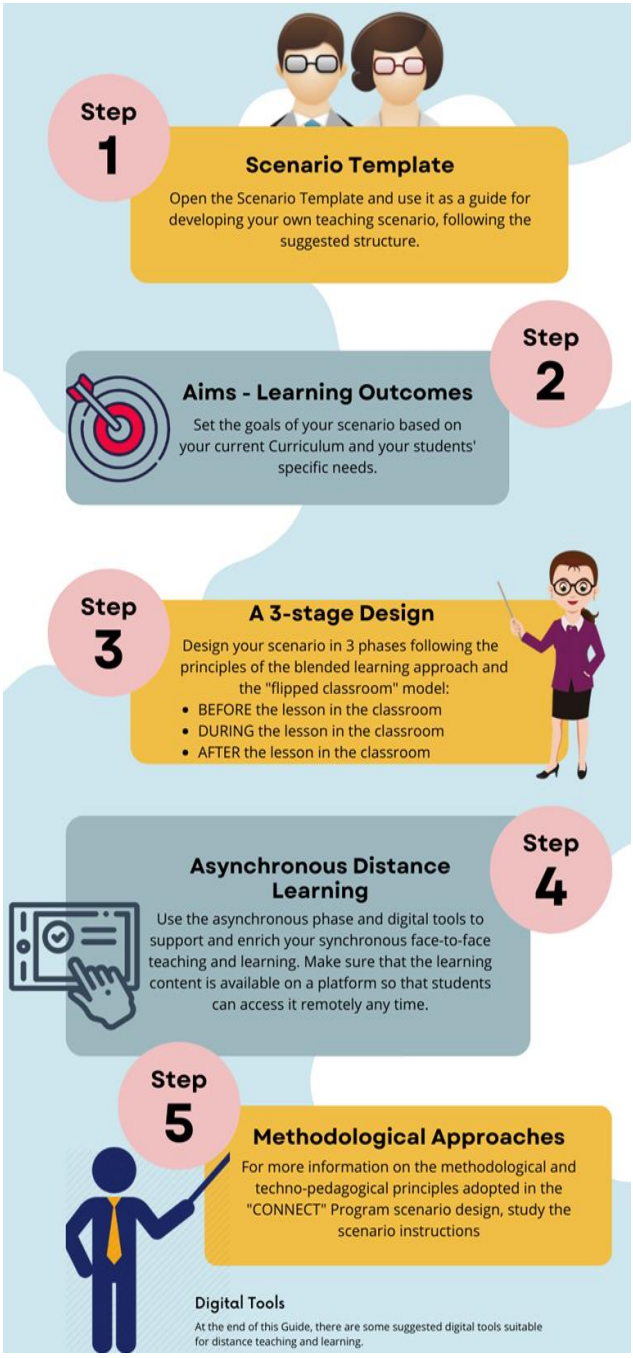

Figure 5.Blended Learning and Flipped Classroom

Given that the main pillar of the CONNECT project is the integration of ICT in the educational process, oriented towards the model of "Blended learning" and the use of practices of the "flipped classroom", the design of educational scenarios emphasizes (Connect Proposal, 2021):

- Distance learning support and enrichment of face-to-face teaching in the form of "Blended learning", through the exploitation of collaborative and interactive digital environments that offer opportunities for asynchronous learning (European Commission, 2020a; European Commission, 2020b; European Commission, 2020c; European Commission, 2021).
- Flipped classroom through reversing roles and processes in the three phases “before”, “during” and “after” in-class activities.
- Use and exploitation of ICT to create a "digital eco-system" of learning "experiences" (Eurydice, 2009).

In the flipped classroom, the teacher has a complex role associated with coherent educational design models that are consistent with the theories of active learning. Under autonomy and flexibility, the teacher develops the educational scenario by outlining its design in the three stages: "before", "during" and "after". The teacher considers the prior knowledge and interests of students and offers challenging activities and a suitable space for the development of learning. The teacher selects and integrates appropriate digital tools and multimodal means, adapts material, and shapes methods that create opportunities for collaborative research and experimentation, justification, and problem-solving. S/he interacts with students by focusing on their difficulties in real practice, and by promoting the development of skills and the acquisition of knowledge by all.

The flipped classroom, unlike the traditional classroom, is non-linear. The linear learning plan is a single-way process and is coordinated mainly by the teacher. Students follow the order defined by the structured lesson plan. In the flexible non-linear learning scenario, students do not follow a predetermined set of teaching and learning activities, either online or face-to-face. Based on students’ learning preferences and prior knowledge, the teacher can select the key points to develop the design of the educational scenario.

In the context of the flipped classroom, when elaborating the Scenario Template, the choices regarding the main factors that shape teaching are justified, and- in each task- brief implementation instructions are added, when necessary. However, not everything is described in full and accurate detail. In a flexible interactive environment, the educational

scenario can be accompanied by less guided worksheets to be open to diverse unpredicted students' interventions and potentially different course development. In the flipped classroom, students are not bound by the educational scenario and the structure of the course. Furthermore, the teacher's increased pedagogical freedom is closely related to accountability (Brewer et al., 2015). In addition, among the teachers in communities of learning and practice (digital and face-to-face) as well as teacher training. There are several versions regarding the building blocks of an educational scenario.

The structure adopted during the design of the CONNECT educational scenario is based on international literature but also focuses on the use of digital tools of distance/asynchronous education to support and enrich face-to-face teaching and learning.

The proposed scenario structure involves the following:

A. Scenario Identity: subject, subject area, age group to which it is addressed and grade/class level, level of language proficiency (for the foreign language scenario), duration (the distinction between face-to-face and distance study, tools and means used, expected learning outcomes (goals and objectives), transversal/soft skills developed by students, pre-acquired knowledge.

B. Summary of the Scenario (apart from a general description of the scenario, it is possible to briefly document the choices of objectives, the theoretical principles adopted, the teaching choices made, etc.)

C. Time-Schedule: briefly report, for each of the activities planned per phase of the scenario (BEFORE, DURING, AFTER) their duration, their purpose, their description, and the tools/means used

D. Detailed description of the scenario: the three phases are described in detail phases of the scenario (BEFORE, DURING, AFTER), the objectives of each phase, all planned activities as well as the evaluation procedures provided per phase.

E. Worksheets: worksheets are a necessary and integral structural element of face-to-face teaching and are intended to be given to students in printed form. It is also possible to provide worksheets (printed or digital) that will be completed by students during the phases of distance/asynchronous study and will be submitted to the teacher either in print (during the lesson) or digitally (e.g. through a digital educational platform).

F. Alternative routes: Alternative ways of implementing the scenario are described. For example:

- For an activity that is planned to be implemented in the computer room, an alternative proposal is provided in case this is not feasible during the implementation of the scenario.
- An activity that is implemented in groups or pairs could be suggested to be implemented individually, as an alternative option.
- A phase of the educational process that is designed to take place, asynchronously, BEFORE instruction, can be alternatively proposed, with the appropriate adjustments, to be done simultaneously during class instruction.
- For a project that provides the creation of a collaborative presentation, an alternative application without the use of digital tools (e.g. a poster, construction in the classroom, etc.) could be suggested.
- For a self-assessment activity done in class, on a worksheet, the alternative application using the appropriate digital tool could be suggested.

G. Reflection: Two (2) “Critical incidents” could be selected, i.e. important “events” of the learning process; the special technological-pedagogical interest could be justified; the didactic design could be presented as well as why they are considered as incidents for reflection to optimize methodological approaches. The elements for reflection are expected to be, both in teacher training, as well as in the implementation of scenarios in class, a means of research and study of practices so that continuous improvement of teaching practice is feasible.

They presuppose the formation of reflective questions that concern the educational planning during the phase of preparing the scenarios, but also the application of the scenarios in class during pilot implementation. These questions are then expected to be an important part of the training process facilitating further critical analysis and collective reflection process, in the framework of creating a community of learning and practice among the teachers of the schools involved in the CONNECT project. The aim is for similar professional communities to operate within the school or among groups of schools, where critical and reflective participation of teachers occur in the planning of their instruction and the context of "blended learning" based on the three distinct stages of the flipped classroom approach (BEFORE, AGAINST THE DURATION, AFTER). It is noted that collaboration in developing the CONNECT educational scenarios and their application in

school practice is of paramount importance. Teachers are active designers who are called upon to develop and introduce innovative practices and enhance their digital skills within a framework of collaborative practice communities. In this context, teachers together with other colleagues and researchers, trainers, educational advisors, or scientific coordinators jointly design educational scenarios, reflect, explore, and analyze cases of teaching practice and think about how to modify certain aspects of teaching. Collaborative development of teaching, critical inquiry as well as reflection are fundamental processes that lead progressively to the development of teachers' professional identity and the development of transferability skills from the design of educational scenarios and training seminars in daily instruction.

H. Bibliography: The bibliography used for the conception, design, and final development of the Educational Scenario is mentioned in the scenario.

I. Annex: It refers to educational material used and given to students either as basic material or as optional material for further study and/or activities' elaboration.

2.3 Assessing Educational Scenarios

Assessing Educational Scenarios is the systematic process of documenting learning through measurable evidence. It is used to measure knowledge, skills, dispositions, or beliefs gleaned through instructional sequences, to improve all aspects of student learning." Assessment in the context of education revolves around the learning goals that will be assessed, the connection of the learning objectives to attitudes and skills, and the selection of the appropriate assessment method. Assessment is beneficial for both teachers and learners. It facilitates students to realize what they have learned and where they stand in the progress of learning achievements, while, on the other hand, teachers obtain information about their student's strengths, weaknesses, and needs, always aiming to further improve their teaching practices. Therefore, academic achievements can be measured and evaluated overall at the end of an instructional period, or the end of a project, unit, course, semester, program, or school year (Brewer et al., 2015). In parallel, assessment can indicate areas for improvement in the learning outcome, and thus effective assessment can lead to an amelioration of learning outcomes.

It is important to denote that the assessment methods depend on the instruction method and the teaching environment. For instance, assessment methods that stand out in face-to face-teaching do not always work well in online environments. In online, or blended courses, students' engagement is critical in their assessment (Brewer et al., 2015).

Collaborative assessment techniques constitute another challenge for the new educational foundation. The introduction of e-learning systems, such as Learning Management Systems, has paved the way for e-assessment. E-assessment refers to evaluating students' performance using potent electronic tools. E-tests, e-Portfolios, and e-assignments stand out in this field.

In detail, online student assessment is conducted on web-enabled devices accurately assessing a student's knowledge in a wide range of subjects, always taking into consideration the curriculum goals. The introduction of e-assessment practices is now considered an integral part of both traditional and online education. Moreover, the innovative use of technology-enhanced assessment has been "a stimulus for change and is of current strategic importance internationally" (Brewer et al., 2015).

E-assessment offers opportunities to teachers for creating innovative assessment practices that help engage students and increase their motivation for learning. The e-learning movement contributes to creating tools able to improve student engagement and performance, offer possibilities to practice competencies and skills and provide personalized feedback, ultimately, improving student motivation. Hence, the impact of online assessment on students' learning may be characterized as beneficial playing a significant role in the teaching/learning process. Learners prefer both the flexibility and convenience of online education (Brewer et al., 2015; European Association for Adult Education, 2018; Gábor & M. Key, 2011), while also indicating expectations for personal achievement comparable to face-to-face learning environments.

However, in practice applying e-assessment requires a pedagogically appropriate model that will allow all students to take more control of their learning exploiting in full the feedback given by teachers as long as "timely and constructive feedback motivates students to learn more effectively". This way learners will become more reflective on the process they participate in. Research shows that effective learning requires that students actively decode feedback information, internalize it, and use it to make judgments of their work".

As regards the benefit of making learners reflective, "reflection can be defined as the process of looking at their experiences by examining actions, reactions, and thoughts to reach a better understanding of the teaching situation". Unless students internalize the process and steps of teaching, will they be willing to fully take part in the teaching,

learning, and assessment process being at the same time motivated?

Although online assessments are developed from conventional forms of assessment by converting their paper-based versions into e-formats, it has been lately realized that this transformation may offer several additional advantages. It can complement traditional forms of classroom assessment making it valid, providing reliable data for student performance, Knowledge, and skills as well as engaging, hence, responding to learner needs. Accordingly, it will constitute a meaningful process, which could be frequently applied (Gábor & M. Key, 2011). So, learners perceive assessment as more relevant to their learning style being at the same time adapted to up-to-date student-teacher interaction. The main advantage of this examination system is that it can be used to administer paperless tests and get instant test results. Lastly, it is worth clarifying that e-assessment, like conventional forms of assessment, should be constantly aligned to the curriculum-stated learning outcomes no matter what types are administered for implementing the assessment.

3 Pilot implementation process

The pilot implementation plan deals with implementing the CONNECT approach based on the designed pedagogical framework and educational scenarios to validate their effectiveness. Teachers from EU secondary schools of the participating countries will first attend the MOOC developed under IO3 for three (3) months. The face-to-face training in Athens will then be asked to deliver a part of the curriculum online (and in complement to the in-class activities) for a week to evaluate the proposed intervention's effectiveness. The CONNECT pilot implementation plan includes the necessary information and activities for conducting the Piloting with samples of users that will gather recommendations and suggestions. The Piloting will be conducted with the support of teachers who possess the required expertise, knowledge, and experience and are competent to provide adequate feedback about the quality and usefulness of the designed pedagogical framework and educational scenarios. The concept of the piloting procedure includes testing the targeted users' acceptance by providing the designed pedagogical framework and educational scenarios to them with a set of assessment instruments and reporting templates. Based on the gathered recommendations and suggestions.

3.1 Describing the Process

The pilot procedure, also known as a pilot study, is a small-scale preliminary investigation conducted to evaluate the feasibility and effectiveness of the CONNECT approach. The main purpose of a pilot procedure is to apply the CONNECT approach before conducting a full-scale study. This can save time and resources and improve the validity and reliability of the results. A small sample of educators and students is recruited during a pilot procedure to apply the CONNECT approach. Data collected during the pilot is based on the flipped classroom on the specific topics of Physics, Mathematics, and Foreign languages. Overall, a pilot procedure is an important step in the research process that can help ensure the success of the flipped classroom at schools.

3.1.1 Objectives

- Strengthening teachers' digital skills and the skills to implement innovative educational practices, such as the flipped classroom (Gábor & M. Key, 2011).
- Enhancing teachers' capacity to develop educational scenarios based on innovative practices such as the flipped classroom but also based on appropriate digital interaction.
- Increasing collaboration between specialist teachers at the school level.
- Improving the learning process (increasing active participation, interactive interaction).

3.1.2 Guidelines for Piloting

The proposed pilot implementation plan of the CONNECT project is part of the response to lessons learned from the COVID-19 pandemic when many pre-existing inequalities were exacerbated and brought to the fore. The pilot implementation plan will take place in all partners' countries – Cyprus, Italy, and Greece. The support planning of the CONNECT pilot implementation; may also inspire long-lasting positive change for blended learning in Mathematics, Physics, and Foreign Languages, embracing innovative pedagogical approaches, including assessment.

The pilot application of the approach is developed during January-March 2023. It focuses on the implementation of the teaching scenarios of Mathematics, Physics, and Foreign Languages in the 3rd Lower Secondary School according to the flipped classroom model. It aims to upgrade teachers' digital skills according to the CONNECT approach and serves the professional development of teachers. In terms of content, teachers are invited to choose or prepare a teaching scenario of their specialty, which is taught according to the curriculum of each partner country during the months mentioned above. Furthermore, the partners work with the schools in their country to secure the digital tools and resources and the technological infrastructure and distance learning platforms for the students (e.g. e - class, e - me for Greece) to be used in the pilot application (see: https://e-me.edu.gr , https://eclass.sch.gr). The preparation of the script is done collaboratively by the teachers of the same specialty of the school, and they are taught individually in the teacher's class(Gábor & M. Key, 2011).

In the context of pilot implementation, peer review can play an important role in ensuring the quality and effectiveness of the implementation. For example, peer review can be used to evaluate the pilot project's design, development, and implementation and identify potential issues or improvement areas. Peer feedback can refine and improve the pilot implementation before it is rolled out more broadly.

Communities of practice (CoPs) are groups of people who share a common interest or profession and engage in ongoing learning and collaboration. CoPs can be found in a variety of settings, including workplaces, educational institutions, and professional organizations.

3.2 Feedback and Reports

3.2.1 For Teachers

3.2.1.1 Pre-pilot Teachers' evaluation phase

The purpose of the survey is to evaluate the teachers' pre-pilot experience in flipped classrooms in terms of obtaining the students' specific learning outcomes (knowledge,

skills, and competencies), fostering students' active participation in learning activities, and improving the whole educational process.

3.2.1.2 Initial Data Collection

Initial Data Collection will be completed before the pilot implementation procedure to mark some initial information from the teachers, especially as a token of preliminary or informal data. The completeness of initial data is identified before analyzing any given dataset.

3.2.1.3 Post-pilot Teachers' evaluation phase

The purpose of the survey is to evaluate the degree to which the desired objectives have been achieved from the teacher's perspective via students' active participation in learning activities and improving the whole educational process.

3.2.1.4 Reflection Diary

The reflection diary is an "account" of the teacher's work in progress, but more essentially an opportunity for reflection on the teaching experience, providing a means of engaging critically and analytically with flipped classroom content. A reflection diary template is analytically presented in Appendix B.

3.2.2 For Students

3.2.2.1 Pre-pilot Students' evaluation phase

The purpose of the survey is to evaluate the students' pre-pilot experience in flipped classrooms in terms of obtaining the students' specific learning outcomes (knowledge, skills, and competencies) via learning activities and the whole educational process.

3.2.2.2 Post-pilot Students' evaluation phase

The purpose of the survey is to evaluate the degree to which the desired objectives have been achieved from the student's perspective through their participation in learning activities and improving their educational process.

3.2.3 Results

3.2.3.1 Pre-pilot Teachers' evaluation phase

The outcome of the Pre-pilot teachers' evaluation phase is centered on the below issues:

- **Increased engagement and motivation:** Flipped classroom led to increased student engagement and motivation by offering a mix of online and in-person learning opportunities.

- **Enhanced learning outcomes:** Blended learning resulted in improved learning outcomes as students can access online resources at their own pace and receive personalized feedback and support.
- **Flexibility:** Flipped classroom provided greater flexibility for both teachers and students, allowing for more individualized instruction and the ability to work around scheduling conflicts.
- **Technological challenges:** Flipped classroom presented technological challenges, such as connectivity issues, that can impact the effectiveness of the approach.
- **Professional development:** Teachers required additional training and support to effectively implement flipped classroom in their classrooms.
- **Cost-effectiveness:** Flipped classroom offered a more cost-effective approach to education as they can reduce the need for physical resources and infrastructure.
- **Data analytics:** Flipped classroom provided opportunities for data analytics, which can help teachers and administrators to track student progress and identify areas where additional support may be required.

3.2.3.2 Initial Data Collection

The initial data of teachers' evaluation phase on the flipped classroom is an important step in the evaluation process, as it provides valuable information for improving the implementation of the flipped classroom approach and optimizing student learning outcomes:

- **Teacher demographics:** Initial data provided information on the demographics of teachers at a school, including age, gender, education level, years of experience, and subject expertise.
- **Teacher effectiveness:** Data collected on teacher effectiveness, including measures such as student performance, student engagement, and classroom observations.
- **Professional development** needs Data used to identify areas where teachers may require additional training or support to improve their instructional practices.
- **Curriculum alignment:** initial data helped to determine how well teachers' instructional practices align with the school's curriculum and standards.
- **Teacher retention:** Initial data provided insights into teacher retention rates and factors that may contribute to turnover.
- **Teacher workload:** Data used to evaluate teacher workload and determine if there are opportunities to reduce workload or redistribute tasks.

- **School culture:** Data provided insights into the school culture and climate, including teacher satisfaction and morale, which can impact teacher retention and effectiveness.

3.2.3.3 Post-pilot Teachers' evaluation phase

The results of the post-pilot teachers' evaluation phase on flipped classroom procedure at schools provided valuable insights and feedback to improve the implementation of the CONNECT approach and optimize student learning outcomes. By using the feedback and data collected from the participating teachers, schools can make evidence-based decisions on how to effectively integrate flipped classroom into their teaching and learning practices:

- **Increased confidence and comfort with technology:** Teachers who participated in a flipped classroom program may have gained increased confidence and comfort with using technology in their classrooms.
- **Improved student engagement and outcomes:** post-evaluation data helped to determine if flipped classroom had a positive impact on student engagement and learning outcomes.
- **Teacher feedback:** post-evaluation data is used to collect feedback from teachers on their experience with blended learning, including areas for improvement and suggestions for future implementation.
- **Professional development:** post-evaluation data helped to identify areas where teachers may require additional training or support to further improve their instructional practices in a flipped classroom environment.
- **Challenges and limitations:** post-evaluation data provided insights into the challenges and limitations of implementing blended learning, such as technological barriers or time constraints.
- **Sustainability:** Post-evaluation data is used to evaluate the sustainability of flipped classroom implementation and determine if it can be continued in the future.

3.2.3.4 Reflection Diary

The key points on a survey about the reflection diary and its impact on the teaching experience based on the flipped classroom are the:

- **Self-awareness:** The reflection diary provided the opportunity for teachers to reflect on their teaching practices, including the flipped classroom content, and gain a deeper understanding of their strengths and areas for improvement.
- **Critical analysis:** Through the reflection diary, teachers engaged critically and analytically with the flipped classroom content and evaluated its effectiveness in meeting learning objectives.

- **Enhanced learning:** The reflection diary served as a means for teachers to enhance their learning by identifying gaps in their knowledge and exploring new teaching strategies and techniques.
- **Professional development:** The reflection diary contributed to teachers' professional development by encouraging ongoing self-reflection and continuous improvement.
- **Improved student outcomes:** Teachers who regularly reflected on their teaching practices were more likely to implement effective teaching strategies and contribute to improved student outcomes.
- **Accountability:** The reflection diary served as a means of accountability, as teachers document their teaching experiences and progress over time, providing a basis for evaluation and assessment.
- **Motivation and engagement:** Regular reflection on teaching practices can increase teachers' motivation and engagement, leading to a more positive teaching experience and improved student outcomes.

3.2.3.5 Pre-pilot Students' evaluation phase

The Pre-pilot students' evaluation phase of the flipped classroom revealed several significant findings:

- **Student engagement:** Flipped classroom procedure improved the students' engagement by giving them more control over their learning and promoting active participation in the learning process.
- **Access to resources:** Teachers via flipped classrooms provided students with increased access to learning resources, including videos, online tutorials, and interactive tools.
- **Improved comprehension**: Pre-pilot students found flipped classroom content more engaging and easier to understand, leading to improved comprehension and retention of information.
- **Time management:** Flipped classroom helped students better manage their time, as they can access learning resources outside of class time and use them for interactive and collaborative activities.
- **Personalized learning:** Flipped classrooms provide students with opportunities for personalized learning, as they can work at their own pace and focus on areas where they require additional support.
- **Technological barriers:** Students encountered technological barriers to accessing flipped classroom content, such as limited access to technology or slow internet speeds.

Teacher support: Students required additional support from teachers to navigate the flipped classroom content and ensure they met learning objectives.

3.2.3.6 Post-pilot Students' evaluation phase

An overview from the survey about the post-pilot students' evaluation phase in the flipped classroom:

- **Improved learning outcomes**: post-pilot students reported improved learning outcomes due to the flipped classroom model, including increased engagement, improved comprehension, and better retention of information.
- **Active participation:** Flipped classroom encouraged more active participation among students, as they could work collaboratively and engage with the content more meaningfully.
- **Personalized learning:** Students appreciated the ability to work at their own pace and focus on areas requiring additional support, making learning more personalized.
- **The technology used:** post-pilot students reported increased comfort with technology use due to the flipped classroom model, which they found to be an essential skill for their future academic and professional endeavors.
- **Teacher support:** Teachers played an important role in the success of the flipped classroom model, providing guidance and support to students as they navigate the content and engaging in ongoing communication with students.
- **Classroom management:** Flipped classroom required careful classroom management to ensure all students could access and engage effectively with the content.
- **Sustainability:** Post-pilot students' evaluation suggested that flipped classroom has the potential to be a sustainable and effective teaching model but requires ongoing support and development to ensure continued success.

3.3 Lessons Learned from Piloting

Some general important lessons that have been learned from piloting are:

1. There is a need to invest in students' collaborative skills and offer students autonomy in the learning process.
2. There is a need for the pedagogical use of digital tools in teaching and a need for teacher to act as a facilitator to enable students to learn in their way.

3. There is a need for a teacher to act as a facilitator, and a need to offer students autonomy in the learning process.
4. When students fail to take over the learning process, frontal instruction is needed.
5. There is a need for cooperation with the IT teacher in laboratory courses.
6. Learning theory at home can be time-saving and effective.

In a course-oriented approach, important lessons have been learned from the implementation of the Mathematics educational scenarios:

1. The best educational practice to implement the Mathematics educational scenarios is the combination of Flipped Classroom with Blended Learning.
2. Collaborative learning is the main ingredient in the successful implementation of Blended learning in the instruction of Mathematics.

In parallel, important lessons have been learned from the implementation of the Physics educational scenarios:

1. It is essential to invest in critical thinking, cooperation, and communication when executing a laboratory experiment.
2. The implementation of Physics educational scenarios calls for building up students' knowledge.

Finally, important lessons have been learned from the implementation of the Foreign Language educational scenarios:

1. It is vital to invest in the instruction of theoretical knowledge at home.
2. Dealing with misconceptions leads to students' upskilling.
3. Peer feedback increases students' engagement.
4. Peer review fosters critical thinking.

It is essential to underline that a couple of studies have proved that peer feedback positively affects students' engagement (Fagen et al., 2002; Crouch et al., 2007). In parallel, an important study has indicated the role of peer review in the promotion of critical thinking (Passias et al., 2014).

3.4 Educational Practices Accentuated in Piloting

The piloting underlined the importance of collaboration at the school level. In this spirit, educational coordinators promoted collaboration among teachers within the school environment in two ways:

1. **Establishing the peer-to-peer review process**. Before implementing the

educational scenario, educators found teachers who teach the same didactic object to act as their peer reviewers. In this sense, educators asked for a review of their educational scenario draft plan before implementing the scenario. Therefore, the possible defects of the educational scenario draft plan were presented to educators and important amendments were made (Passias et al., 2014).

2. **Creating Communities of Practice.** Before implementing the pilot, educators could join a community of practice where teachers and educational coordinators exchanged ideas that could be materialized in the implementation process. In parallel, when a specific educator completed his/her pilot, he/she shared this experience with other members participating in the communities of practice, and all members could contemplate the problems encountered, the pilot reverberation, and the lessons learned from piloting. Reflection diaries were a powerful tool exploited in the communities of practice (Passias et al., 2015; Passias et al., 20222a; Passias et al., 2022b).

The good piloting outcome in all partner countries proved that teachers embraced this new strategy. Peer review and communities of practice moved the "collaboration climate" to another level.

Piloting Reverberation

Drawing from the reflection diaries and the final schools' reports, some important aspects have marked the piloting success:

1. The Peer-to-peer review and the communities of practice contributed to the effective implementation of the "Connect" Educational scenarios.
2. Educational coordinators and School authorities secured a good school climate during piloting.
3. The employment of the Flipped Classroom Approach fostered student and teacher collaboration.
4. The critical didactic incidents played an important role in promoting students' active participation.
5. The use of digital tools made the implementation of flipped classroom more attractive and contributed to unique learning experiences.

4 The Need for Attractive Activities

The flipped classroom is an approach that reverses traditional teaching by delivering instructional content to students outside of class, usually through videos or readings, and using class time for discussion, problem-solving, and other interactive activities. Engaging activities for flipped classrooms refer to engaging and interactive learning experiences that can be incorporated into this approach to enhance student engagement and learning outcomes. These activities could include interactive online quizzes, virtual labs, collaborative problem-solving, inquiry-based learning, interactive language practice, cultural immersion, and other innovative approaches that encourage active participation and critical thinking skills. These activities aim to create a dynamic and engaging learning environment that helps students learn more effectively and achieve better outcomes. The Greek attractive activities are analytically presented in Appendix A. These activities are classified according to the respective Course. Therefore, there are activities for Mathematics, Physics, and Foreign Language.

4.1 Activities for Mathematics

The Activities for Mathematics include the below didactic objects:

A. Pythagorean Theorem.

B. Rectangular parallelepiped and cylinder.

C. Learning Activities KAHOOT.

D. Designing an algebraic expression.

4.2 Activities for Physics

The Activities for Physics include the below didactic objects:

A. Activity on the Coulomb's Law.

B. Activity on Newton's 3rd Law.

C. Exploring Sound

The Activities for English are designed for the below didactic object:

- Graffiti versus Street Art (Think-Pair-Share, Jigsaw, Digital Escape Rooms, Fishbowl Strategy, and Tic Tac Toe)

The Activities for French are designed for the below didactic object:

- Speaking about myself (The "Millionaire Game")

5 Implementing the CONNECT approach in school teaching

5.1 The Instruction of Mathematics

The CONNECT approach suggests two important methods for the instruction of Mathematics:

1. Critical Didactic Incidents (Souralis, 2023)
2. Problem-Solving (Kosyvas & Glinou, 2023)

Critical Didactic Incidents

The term Critical Incident (CI) is usually defined as a teaching moment that a teacher attends to and considers to be significant (Goodell, 2006. Skott, 2001. Potari & Psycharis, 2018. Souralis, 2022). The CI concept is used by teacher educators and researchers to gain access to teaching and learning phenomena and trigger the professional development of mathematics teachers. Although other researchers do not label the concept as CI, they use the teaching moments the teachers identify as significant, to study the teachers' noticing skills (Callejo & Zapatera, 2017. Amador & Carter, 2018. Van Es & Sherin, 2006. Star & Strickland, 2008). The 3-dimensional noticing concept consists of the dimensions: attend to, explain, and respond accordingly (Potari & Psycharis, 2018). Goodell (2006) frames CIs by the dimensions: of understanding, classroom management, student motives, student relations, and student behavior while Van Es and Sherin (2006) frame the CIs by the dimensions of Who and What. Van Es & Sherin (2006) are studying what teachers attend to during teaching and how they explain it and their development through a professional development program. They concluded that teachers finally focus on students' mathematical thinking.

Rotem and Ayalon (2022) are studying the kind of CIs teachers attend to. They are using a narrower definition of CIs describing them as teaching moments where the students' thinking about mathematics is clear and creates opportunities for them to have a deeper understanding. Their framework consists of the dimensions: Teaching & Learning, Agency, and Topic. In the teaching & learning dimension, the analyses showed 3 categories: affective (if it is about emotions), cognitive (individual), and social (it reveals some kind of interaction with others such as the teacher connecting to students' ideas (Rotem & Ayalon, 2022).

The critical didactic incidents are presented in the CONNECT approach Handbook (Page 43), which is available at the link

Problem-Solving

A lot of researchers have emphasized the importance of engaging students in problem-solving activities related to real mathematical concepts (Schroeder & Lester, 1989; Schukajlow & Krug, 2014; Große, 2014; Cai & Cifarelli, 2005; Silver et al., 2005; Kosyvas, 2016). Students' involvement in different problem-solving methods results in developing reasoning that enables them to explore important mathematical ideas and to achieve the learning objectives dictated by the Curriculum (Schoenfeld, 1992; NCTM, 1991). According to research data, problem-solving practices contribute to the development of high cognitive and communicative skills and the enhancement of students' conceptual understanding (Van de Walle, 2003; Kosyvas, 2017). Problem-solving activities in the classroom allow students to improve, combine, and modify the knowledge that has been acquired (Hiebert et al., 1997). The Problem-Solving technique considering collaborative learning is presented in the CONNECT approach Handbook (Page 32), which is available at the link

5.2 The Instruction of Physics

The CONNECT approach suggests two important methods for the instruction of Mathematics:

1. Investing in Students' Alternative Ideas (Stefanidou, 2023)
2. Inquiry-Based Learning (Pefanis & Apostolopoulos, 2023)

Investing in Students' Alternative Ideas

Alternative ideas are intertwined with the constructivist model of teaching in which either the conflict between students' alternative ideas, which are acceptable at the level of everyday life, as well as scientific ideas, which are acceptable at the classroom level, or the modification of alternative ideas are important. These situations, whether they involve conflict or not, teachers are asked to deal with (Chalkia, 2012).

However, in recent years, the inquiry model of teaching and learning has prevailed as a model suitable for familiarizing students of all levels with scientific methodology, in the sense of familiarizing students with scientific procedures. In the context of the inquiry approach, students are asked to make specific hypotheses about the phenomena under consideration, which also determine the corresponding experiments to confirm or reject them (Skordoulis & Stefanidou, 2021).

Students gradually construct their knowledge of the world through their everyday experiences inside and outside of school. Many times, the explanations they construct for

natural phenomena may not match scientific explanations. These student ideas are known as alternative conceptions or misconceptions (Driver et al., 1994). The Students' Alternative ideas are presented in the CONNECT approach Handbook (Page 18), which is available at the link

Inquiry-Based Learning

The proposed scenarios of the CONNECT project use the principles of inquiry-based teaching and differentiation supported by the methodology of the flipped classroom model. According to these principles, the course is organized and conducted in three (3) Phases. During Phase A, students are provided with a variety of educational content (websites, texts, audio files, video files, photos, etc.) for individual study which must:

a) focus on declarative knowledge so that the student can manage it on his/her own,

b) motivates students and boosts their interest in the teaching content,

c) relates to the designed inquiry activities of Phase B, which will be carried out by the students, in the classroom.

The knowledge is constructed by learners themselves whereas the process of constructing new knowledge begins with what is already known and takes place with internal cognitive processes that lead to the construction of mental models of how the real-world works, which can be used to solve problems. Certain ideas that structure students' existing mental models lead to an inadequate or incorrect understanding of how the phenomena in question work in science. In other words, they refer to a kind of conceptual difficulty that the student encounters (Smyrnaiou, 2014). Taking the above into account, we considered the students' alternative ideas to be a key element of the educational process.

When teaching a new module, it is necessary to assess whether these alternative ideas raise serious obstacles for many students and should be placed at the center of the educational process. The Inquiry-Based Learning is presented in the CONNECT approach Handbook (Page 88), which is available at the link

5.3 The Instruction of Foreign Language

Two methods that stand out in the CONNECT approach for Foreign Language are:

1. Differentiated Instruction (Tigka, 2023)
2. Reflection through Critical Learning Incidents (Gyftoula, 2023)

Differentiated Instruction

The focus on de-tracking (Smale-Jacobse et al., 2019; Tomlinson et al., 2003) to enhance educational equity and in-class alignment has accentuated the complexity of the teacher's role in terms of attending to learner needs.

It has been argued (Tomlinson et al., 2003) that teaching may be differentiated across the curriculum (i.e., through student allocation to graded difficulty groups), process (i.e., through teaching methodology adjustment), resources (i.e., through modifying lesson materials), and student outputs (i.e., through suggesting different ways of learning). Moreover, teachers may diversify the allocated time by providing either more for the low achievers or less for advanced students (Smale-Jacobse et al., 2019).

Differentiated instruction could be viewed as a deliberate reaction to the feedback perceived by the teacher whose purpose is to maximize the potential of all students. Differentiation could be either convergent or divergent (Smale-Jacobse et al., 2019). By the former term, it is intended that the teacher focuses on the weak students and supports them to attain the top of their potential. Convergent differentiation, which is an act of in-class alignment and justice, minimizes the gap between high and low performers. On the contrary, when the teacher diversifies the lesson without excluding any student and modifies learning objectives, processes, and outputs they apply divergent differentiation. Inherent in differentiated instruction is the belief that learner differences are dynamic, which provides the conditions for adaptable grouping (Coubergs et al., 2017). These differences may vary from cognitive to interests, prior knowledge, and learning profile (Sweller, van Merriënboer, & Paas, 1998; van Merriënboer & Sweller, 2005). The Differentiated instruction is presented in the CONNECT approach Handbook (Page 13), which is available at the link

Reflection through Critical Learning Incidents

According to Soini (2012), critical learning incidents are learning situations that "…learners have experienced as effective, exceptional, or personally meaningful" and they can "… lead to educationally significant learning and personal growth". As is the case with most terms used in educational literature, its origin lies in a different field. In this case, John C. Flanagan, a psychologist developed the critical incident technique (CIT) during World War II in his effort to understand why airplanes crash. He describes CIT as "…any activity that is sufficiently complete in itself to permit predictions to be made about the person performing the act" (Flanagan, 1954: 335). Much later, other researchers (Tripp, 1993; Thiel, 1999; Farrell, 2008) investigated and suggested structured frameworks for analyzing critical incidents all of which recognized the contribution of reflective thinking to the development of learning strategies. Finch (2010) discusses these ideas from the perspective of language learners recognizing that learning is a complex, multi-level, and ever-evolving process that might be interrupted, slowed down, or accelerated by various

factors. Reflection through Critical Learning Incidents is the pillar of the "Connect" Educational Scenarios for Foreign Languages. The Reflection through Critical Learning Incidents is presented in the CONNECT approach Handbook (Page 51), which is available at the link

5.4 Collaborative Learning

Collaborative learning has lately drawn the attention of the educational community due to its key role in fostering an interactive learning environment for students (Papahristou, 2023). In particular, the need for collaboration amongst learners arises as an imperative need in the present era in a complicated classroom and is suggested to be more and more essential. Therefore, it is crucial to understand in depth the dynamics of collaboration as well as the extent to which it can positively affect the teaching and learning process per se.

Collaboration entails an attitude of communicating with other people requiring individuals to be responsible for their actions to solve a problem. Collaboration is a "coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem" (Rochelle & Teasley, 1995). It involves individuals in the process of learning to respect the abilities of others as well as respecting their support in the completion of a specific task.

Rowse & Emerson (2016) support that "collaboration is a key facilitator of cognitive development in early childhood; knowing which factors influence cognitive development during collaborative exercises for young children has implications for educators in terms of academic outcomes and well-being". Learning to collaborate, then, has its roots in early childhood whereas learning to interact can have a substantial, positive effect on one's cognitive development.

Collaborative learning has long been a teaching approach in the English language classroom in which learners are required to accomplish a task getting involved actively in their group and sharing with their classmates a common goal (Arta, 2018). It is true that, only in this case, can learning be meaningful to students. Only when the teaching and learning process is attuned to the needs, goals, and strengths of a learner, "students are not passively absorbing information, but are actively involved in constructing meaning from their experiences and prior knowledge. Rather than just receiving more information, the learner must make sense of the information with the help of his/her learning community" (Stein et al, 1994). Collaborative learning is a teaching method developed for over 40 years, and its effects on various areas such as student success, attitude to learning, and motivation are proven by research. "Over the last decades, research has demonstrated that collaborative learning can promote academic and social educational outcomes (Slavin, 1996 in Le, Janssen & Wubbels, 2016)".

Furthermore, according to Johnson and Johnson (1999), the social interdependence

theory brought forward by Lewin and Deutsch is the foundation of the collaborative learning method designating important insights for its implementation in the English Language classroom. Social interdependence theory posits that individuals are affected both by their acts and those of other individuals (Johnson and Johnson, 2012). Therefore,

the prominence of a collaborative approach is stressed for the students to achieve common educational goals, a process which must be not only a joint effort but also requires that every student holds responsibility for the process students are involved in for the successful completion of tasks and activities.

Collaborative Learning is presented in the CONNECT approach Handbook (Page 108), which is available at the link

5.5 Peer Assessment and Communities of Practice

The quality of an education system cannot exceed the quality of its teachers (MacBeath, 2001). According to international studies, the effectiveness of educational reforms in a changing and increasingly complex world (knowledge societies and economies, digital world, 4th industrial revolution, risk, and precarious societies) depends on the individual and collective capacity of teachers to promote new forms of learning in schools (OECD, 2005; European Commission, 2013).

The transformation of the school into a learning organization and a community of learning (SLO) is an evaluative imperative in modern knowledge society. The SLO is a modern, distinct, alternative educational paradigm of a living, learning, evolving and continuously improving organization. The SLO constitutes a dynamic process of continuous learning, governance, and transformation (Pasias, et al., 2022a). “Learning for all” is a core value of the SLO and concepts such as trust, collaboration, reciprocity, creativity, and change are integrated into its policies and practices (Senge, et al. 2012, Kools& Stoll, 2016; Pasas, 2023).

In schools transforming into SLOs, teachers are organized in professional learning communities (PLCs). The ‘learning community'' is made up of groups of teachers who share and critically explore their practice in an ongoing, consistent, collaborative, inclusive, learning-oriented, developmental way. They are communities of continuous inquiry and improvement that utilize collaborative learning to improve teachers’ professional competencies and learning outcomes (Harris& Jones, 2010; Marsick, et al., 2013).

‘Learning’ is the primary objective of the SLO and the core of its assessment rationale and strategies. It is supported by a wide range of procedures which includes systematic data collection, interpretation and utilization, evidence-based decision-making, and dissemination of good practices. These procedures aim at the collective learning of the

organization, teacher professional development, the enhancement of teachers', and students' competencies, and the improvement of the learning processes and outcomes (Andrade, et al, 2021, Caena & Vuorikari, 2022).

In the SLO, teachers as professionals are required to respond to a dual role concerning assessment: they are required to assess and be assessed, act as evaluators, and evaluate at the same time. In this condition, three different types of assessment coexist,

complement each other and are exploited by teachers: a) assessment of learning, b) assessment for learning, and c) assessment as learning (Pasias, et al., 2022b).

Current trends in education promote a gradual shift from summative assessment and assessment of learning towards formative types of assessment such as assessment for learning and assessment as learning (Hume, & Coll, 2009, Earl, 2013, Dann, 2014, Laveault & Allal, 2016, Yan, & Boud, 2021). In the SLO paradigm, the focus is on the transition from the level of'' learning to the level 'of' learning and to that of 'as' learning as a transformational process for the teacher and student subjectivity (Pasias, et al., 2022b).

Teacher peer assessment is a dynamic method of evaluation, reflection, and improvement that supports the school's transformation into a learning organization and a community of learning. It is directly linked to teacher professional development and individual teacher evaluation establishes a collaborative culture in the community, it transforms learning into a collective process, and it aims at school improvement (Chism, 2007).

Peer assessment is an essential collaborative practice, it functions as a learning process for teachers and is an informal form of school-based evaluation that can be applied to all aspects of educational practice. It is usually applied in the context of teaching, but it also applies to all teaching activities. It is considered one of the most successful techniques for improving teaching and pedagogical practices and is perceived as a supportive, open, flexible, non-bureaucratic kind of evaluation based on reciprocity, trust, self-direction, and self-regulation (Pasias et al., 2015).

The pedagogical and developmental nature of peer assessment empowers peer-collaborative learning of teachers and students. The formative character of the process is exhibited in the transformation of teachers' perceptions and dispositions to improve competencies, the development of new modern teaching strategies and educational practices, and the formation of a much-desired culture of collaboration, collegiality, and evaluation in a school 'learning community' (Gosling, 2014; Fletcher, 2018). A key feature of 'peer assessment' is reciprocity and the sharing of knowledge, ideas, and experiences between participants, so that they are eventually led to peer-to-peer learning, which is a bilateral, interactive learning activity. A prerequisite for the successful outcome of this collaborative peer practice is that there are no distinct roles between the observer and the observed, as they take turns to achieve the best results (Apostolopoulos, 2014).

The central consideration of 'peer assessment' is to view the school as a single collective

entity and to assess the educational work produced holistically, so that the focus of the evaluation process shifts from the control of performance and achievement to the interactions of the participants during the learning processes and the meanings that are formed (Pasias, et al., 2022b).

The introduction of 'peer assessment' in school is a key dimension of its self-evaluation processes (at both individual and collective levels). It reflects a substantial paradigm shift

in the way learning at school is assessed as the focus shifts from external to internal assessment. More specifically, the following transitions are highlighted:

- from inspection that fosters fear and surveillance to forms of collective internal assessment that construct new knowledge and learning,
- from the external inspector/school counselor to the reflective-researching teacher,
- from the summative to the formative character of evaluation,
- from the culture of fear and demonization of evaluation to the culture of reciprocity, solidarity, and trust among teachers,
- from defensive isolation to professional, collaborative, peer-to-peer learning,
- from pedagogical solitude to critical and reflective dialogue (Pasias, et al., 2022b).

The Peer Assessment is presented in the CONNECT approach Handbook (Page 182), which is available at the link

5.6 The Need to Implement the Flipped Classroom Approach

The flipped classroom is a "pedagogical approach where the learning space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter". Both high school chemistry teachers, Jonathan Bergmann, and Aaron Sams first introduced the flipped classroom concept. In their book: *Flip your classroom: Reach every student in every class every day*, they discussed a couple of reasons why teachers should consider flipping (Bergmann & Sams, 2012):

- Flipping speaks the language of today's students.
- Flipping helps busy students.
- Flipping helps struggling students.
- Flipping helps students of all abilities to excel.
- Flipping allows students to pause and rewind their teacher.

- Flipping increases student-teacher interaction.
- Flipping allows teachers to know their students better.
- Flipping increases student-student interaction.
- Flipping allows for real differentiation.
- Flipping changes classroom management.
- Flipping changes, the way we talk to parents.
- Flipping educates parents.

- Flipping makes your class transparent.
- Flipping is a great technique for absent teachers.
- Flipping can lead to the flipped mastery program.

6 Keynotes of the LTTA and European Multiplier Event (Greece)

The LTTA and the European Multiplier Events in Greece proved to be educational milestones. This appendix presents the keynote points of these events:

KEYNOTE POINTS:

1. The implementation of Flipped Classroom is feasible, but it requires a change of roles.
2. Digital tools should be integrated into daily teaching.
3. Collaborative learning yields fruits.
4. Problem-solving approaches have their place in the instruction of positive Sciences.
5. The benefits of differentiated instruction should not be disregarded.
6. Investing in critical didactic incidents and students' misconceptions promotes active learning.
7. Peer-to-peer review upgrades the school climate.
8. There is a need to employ up-to-date practices in student evaluation.
9. Inquiry-based learning is beneficial in the instruction of Physics (Ali, 2014).
10. Developing 21st-century skills leads to professional development.

A greater overview of the LTTA and EME is given in the material uploaded to the "Connect" project's website.

(https://connect-erasmusproject.eu/images/CONNECT_handbook_final.pdf)

7 Final Teacher's Guide (Added value and Perspective)

The FTG helps educators to implement the CONNECT approach. As it has been highlighted, implementing the CONNECT approach at Schools can lead to teachers' professional development. Additionally, important elements such as attractive activities, educational scenarios, and proposed methods are presented in a course-oriented approach that is tailored to the needs of Mathematics, Physics, and Foreign Language. In this sense, the Teacher's Guide directions apply to these didactic objects.

The added value of these activities lies in the fact that they can be easily implemented. Along with the educational scenarios, the attractive activities are based on a robust pedagogical framework and therefore they can be implemented in terms of any educational curriculum. Thus, similar attractive activities can be designed by European educators in alignment with their curriculum. This European educational compatibility and interoperability is also a feature of the educational scenarios.

The CONNECT Educational scenarios can be implemented by European educators, making slight amendments, according to liable curriculum incompatibilities. This proved true in the case of the Italian scenarios in Physics. The CONNECT Educational scenarios are based on up-to-date educational practices that prevail in the international educational establishment. As an illustration, global research has stressed the importance of the "Connect" Educational practices, an argument that has been supported by the respective bibliography.

Another important aspect of the CONNECT approach that has also been highlighted in the FTG is the need for reflection. Teachers who participated in the Learning Teaching Training Activities (LTTA event), learned how to reflect on their teaching methods. Multiplier events also answered the same purpose. Teachers who participated in the CONNECT pilot in all partner countries used the reflection tool to succeed. It is important to point out that the FTG refers to a powerful reflection tool that was developed to cover the needs of piloting. This tool is called a "reflection diary".

Each European educator can create his/her reflection diary to help him/her contemplate his/her teaching methods, and evaluate their success. The reflection diary template that is presented in this Intellectual Outcome can be helpful. However, it is important to realize that the reflection diaries should not only be used under specific circumstances, such as piloting. The reflection diaries should be generally used by educators in their daily life. This process can ensure educators' professional development. Global research (included in the respective Intellectual Outcome) has pointed out that reflection is a lifelong need, and that professional development depends on the quality of the teachers' self-evaluation. LTTA and Multiplier events accentuated this process.

The Final Teacher's Guide development team wishes all educators around Europe to have a good implementation and an outstanding professional development!

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9 Appendix A: Attractive Learning Activities (Greek Teachers)

Mathematics (Brousseau, 1970-1990)

Pythagorean Theorem

Creator	RDPSEA
Course	Mathematics
Didactic unit	Pythagorean Theorem
Estimated Time	45 minutes
Learning objectives	The activity aims at improving the conceptual understanding of the Pythagorean Theorem. The activity is designed to be completed before introducing the algebraic formula and after its proof. The activity emphasizes inquiry. Students are asked to formulate a conjecture and to test it. It also connects algebraic and geometric ideas and it provides a general pattern.
Target Group	14-year-old students
Description	**(a)** Copy the table below into your notebook. For each row of the table: Draw a right triangle ABC ($\hat{A}$ = 90) considering the given length of the vertical sides on the dotted sheet (square canvas). Draw a square on each side of the triangle.

Find the areas of the squares and fill in the data on the table.

Length of Perpendicular Side AB (units)	Length of Perpendicular Side AC (units)	Area of Square on the Perpendicular Side AB (sq. unit)	Area of Square on the Perpendicular Side AC (sq. unit)	Area of Square on the Perpendicular Side BC (sq. unit)
1	1	1	1	2
1	2			
2	2			
1	3			
2	3			
3	3			
3	4			

(b) Remember that conjecture is the best idea for guessing a mathematical relationship. It's usually a generalization of a pattern that you think may be correct, but you are not aware of its correctness. For each triangle, identify a relationship between the areas of the three squares. Come up with a conjecture regarding the squares you drew on the sides of each right triangle.

(c) Draw a right triangle in a way that the sides' lengths could be different from those given in the table. Use your triangle to check the conjecture based on the question (b).

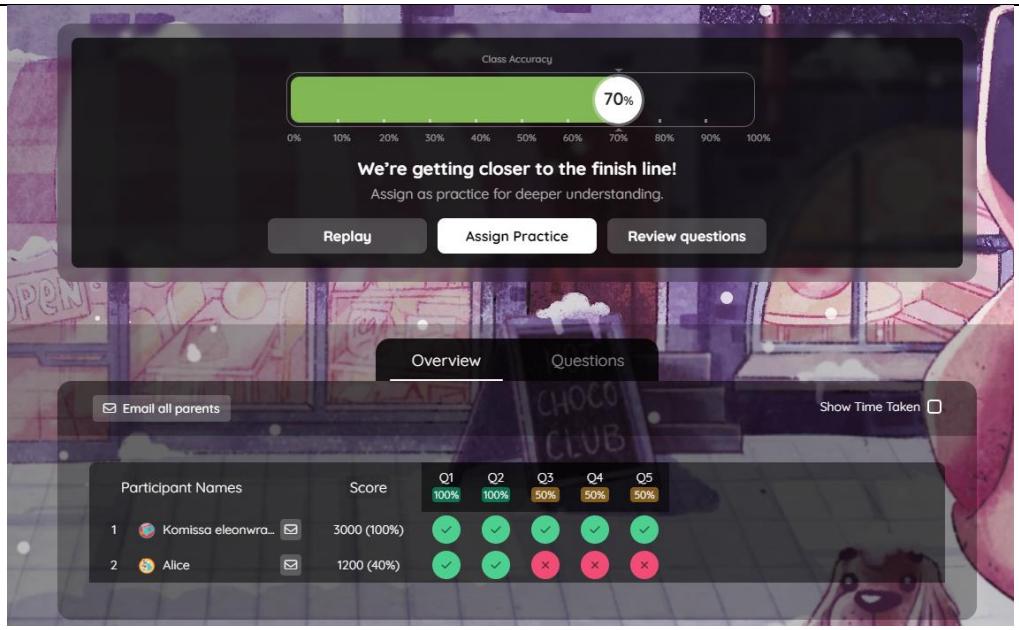
Rectangular parallelepiped and cylinder

Creator	RDPSEA
Course	Mathematics
Didactic unit	The volume of rectangular parallelepiped and cylinder

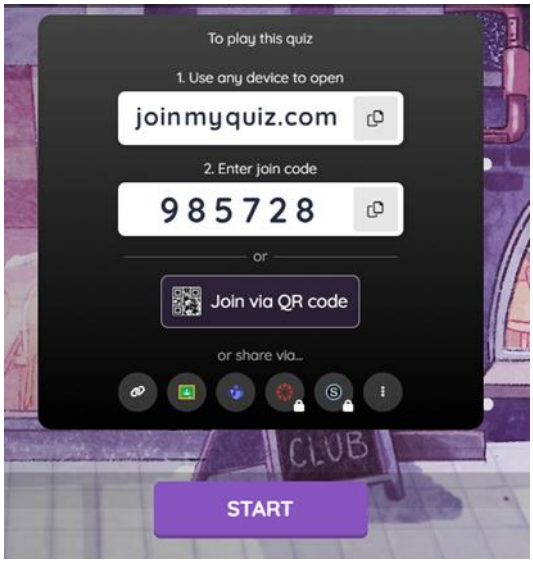
Estimated Time	90 minutes
Learning objectives	It is an experiential activity drawn from students' daily life. Students should be able to: • calculate the volume of the rectangular parallelepiped and the cylinder. • verify their answers in real cases.
Target Group	14-year-old students
Description	 **The planters**: *Outside the classroom, there are 3 identical empty rectangular parallelepiped planters measured to be 81.2X31X36 centimeters. The students of the class were divided into three groups. Each group of students must cover a planter with natural potting soil. They can use: a) small containers, the radius of which is 8 cm and the height is 25 cm, and b) large containers, the radius of which is 10 cm and the height of 32 cm. Group A is given cylindrical containers, group B is given large containers and group C is given both small and large containers.* ***a)*** *How many pots of potting soil must each team carry to cover the planter?* ***b)*** *Transfer containers full of topsoil from the school garden to your planter and verify your calculations.*

Learning Activities KAHOOT (Xezonaki, 2023)

Creator	RDPSEA
Course	Mathematics
Didactic unit	Pythagorean Theorem
Estimated Time	15 minutes
Learning objectives	Revision exercise on the Pythagorean Theorem
Target Group	Students 14 years old
Description	This activity is a revision quiz, that was created using the application https://quizizz.com/ and is supposed to be used for the students that have studied the Pythagorean Theorem and the squared roots. This exercise can be used by teachers on students' evaluation, on https://quizizz.com/admin/quiz/63aafa3f042ca4001ed5a201?source=quiz_share. This quiz can be used as a gamification application, either in face-to-face teaching or in the third phase of distance learning, in education. This game provides each student with his/her results and allows students to evaluate their experience playing. The teacher can send the results to the parents via e-mail and can estimate the overall time needed for the completion of the exercises by the students.

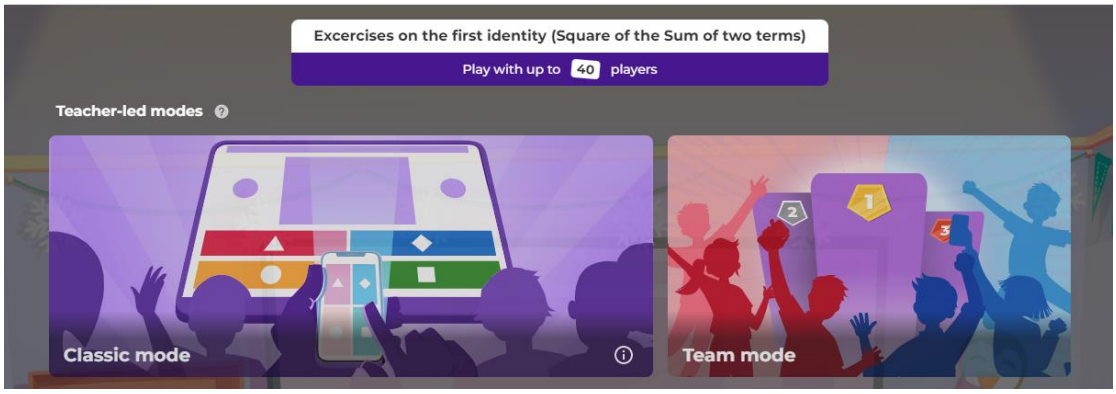


We advise students to enter the site joinmyquiz.com and we provide them with the number that needs to be entered so that they can play the game (985728). The duration of every exercise is set by the teacher. In this example, two minutes are given per exercise.

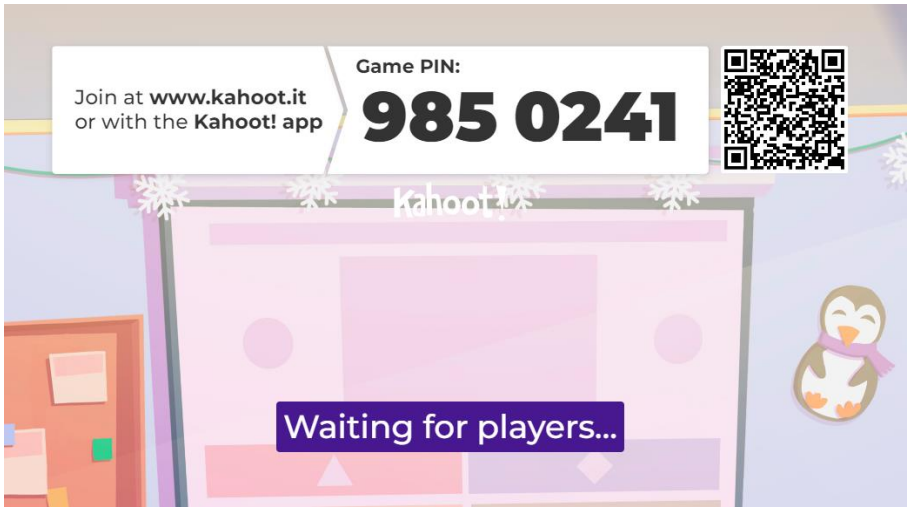


Kahoot Attractive Learning Activities

Creator	RDPSEA
Course	Mathematics
Didactic unit	Teaching the identity $(a+b)^2=a^2+2ab+b^2$
Estimated Time	Approximately 10 minutes
Learning objectives	Use the identity $(\alpha+b)^2=\alpha^2+2\alpha b+b^2$ in solving exercises. Give feedback on learning, understanding, and using the identity $(\alpha+b)^2=\alpha^2+2\alpha b+b^2$
Target Group	15-year-old students
Description	The task can be found at: https://create.kahoot.it/share/excercises-on-the-first-identity-square-of-two-factor-sum/d4951c74-b877-471e-b4f2-98615d368b2d According to sources, 80% of students tend to use playing games as a way of learning. The use of gaming concepts and procedures in the learning process makes up the notion of gamification. It aims to attract users to come in contact with non-gaming subjects, through gaming. The teacher can use either the classic mode or the team mode of the game, according to the plan of his/her lesson. The activity can be used in phase C (after the lesson - Distance Learning-asynchronous) as an assessment test for the understanding and application of the identity $(\alpha+b)^2=\alpha^2+2\alpha b+b^2$. The test has been created on kahoot.com. The teacher can either get the reports for every student, by signing up/ logging in, or he/she may continue navigating as a guest, without access to the results.

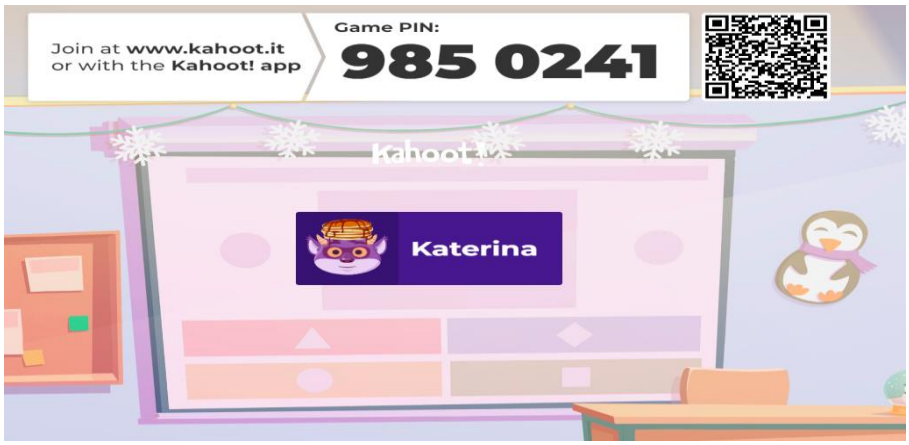


Students can join the game at www.kahoot.it where they may be given the game pin. In every game, there is another pin.

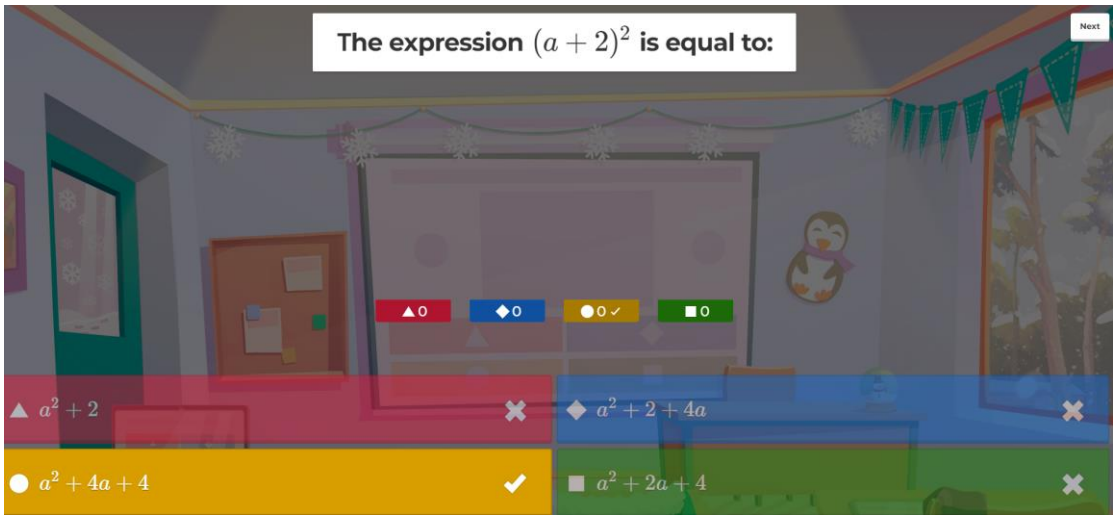


When students join the game, we may have the necessary access to their nicknames.

We invite the students to enter www.kahoo.it and enter the given game pin.

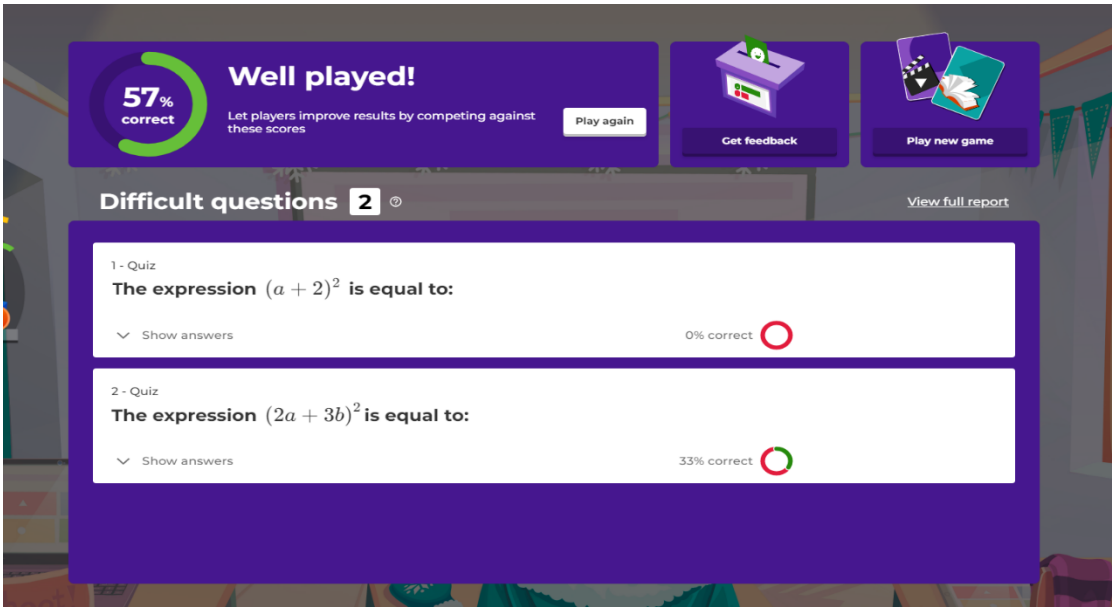


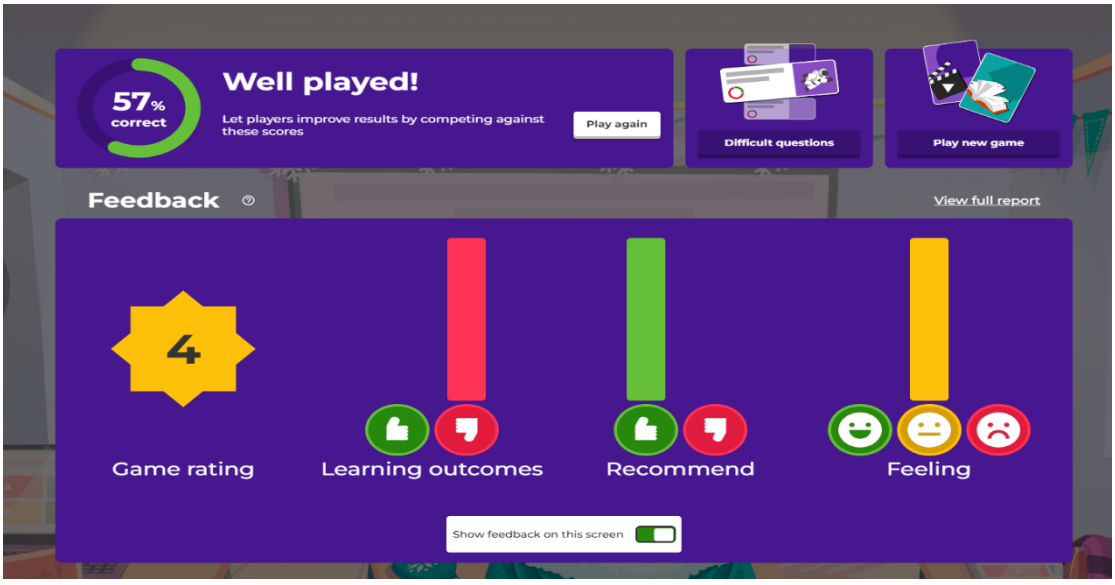
Students must choose the correct answer.



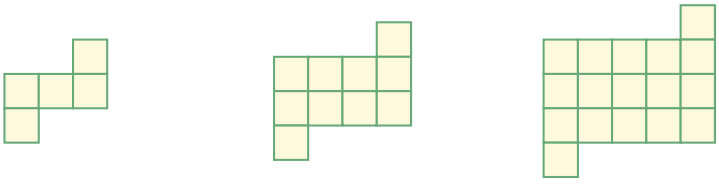
The teacher may have access to the student's answers. He/ She may note the questions which had a great number of false answers, so that he/ she may organize their teaching material and revisions. After the game ends, the application kahoot.com, using gaming, presents the 3 players with the highest scores and shows the questions with the falsest answers. It also allows students to evaluate their experience playing the game, providing the teachers with the necessary feedback on whether this game helped students learn, how they feel about it, and whether they recommend it.

The only noted difficulty is that when students use their smartphones to play the game, they can only see the possible answers as color options and not as phrases- a screen that shows the answers as phrases are necessary for the classroom.


57% correct
Well played!
Let players improve results by competing against these scores
Play again
Get feedback
Play new game
Difficult questions 2
View full report
1 - Quiz
The expression $(a+2)^2$ is equal to:
Show answers
0% correct
2 - Quiz
The expression $(2a+3b)^2$ is equal to:
Show answers
33% correct


57% correct
Well played!
Let players improve results by competing against these scores
Play again
Difficult questions
Play new game
Feedback
View full report
4
Game rating
Learning outcomes
Recommend
Feeling
Show feedback on this screen

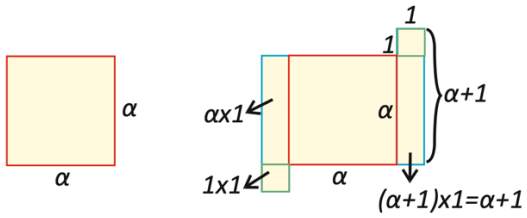
Designing an algebraic expression (Radford et al., 2007)

Creator	RDPSEA
Course	Mathematics
Didactic unit	**Designing an algebraic expression**
Estimated Time	Approximately 90 minutes
Learning objectives	• Expansion, generalization, remarkable identities, the transformation of algebraic expression, and area of rectangles. • Figurative and evolutionary patterns, finding the rule, recursion, generalization, investigation, and reasoning.
Target Group	15-year-old students
Description	**Problem A: Design an algebraic expression** **a)** Represent geometrically the expression $\alpha^2 + 2(\alpha + 1)$ where a is a positive number. **b)** Show that, whatever the value of the positive number a, the following four expressions are equal: $\alpha^2 +2(\alpha+1)$ $(\alpha+2)^2 -2(\alpha+1)$ $\alpha(\alpha+2)+2$ $\alpha^2+2\alpha+2$ **Problem B (Pattern): the small squares** With small identical squares, we construct a pattern according to the evolutionary model below. Find a way to count the number of small squares of an element of any step.  Step 1 Step 2 Step 3

Teaching guidelines

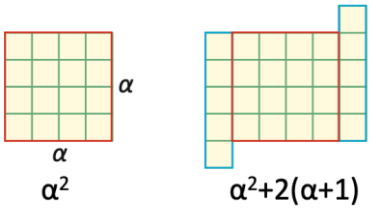
Problem A: Design an algebraic expression (45 minutes)

In the context of differentiation, recourse to manipulative material is suitable for the formation of mental representations. From the given shape, students create the expected shape.



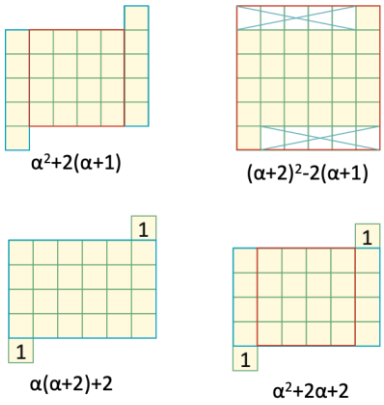
α^2 $\alpha^2 + 2(\alpha+1)$

The square can be divided into smaller unit squares. In this case, the 4x4 square is an example. However, we are referring to the general case axa.



B. Problem B (Pattern): the small squares (45 minutes)

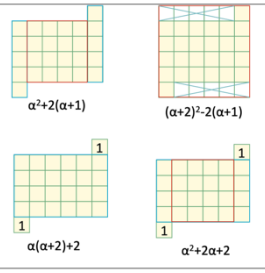
This approach promotes the formation or stabilization of mental representations of the distributive property and the product. The proposed geometric approach has the advantage of reducing shape errors $\alpha(\alpha + 2) = \alpha^2 + 2$.



- The meaning of each algebraic expression is formed using **rectangle area representations** (rectangular numbers, product expression).
- Geometric interpretations make it possible to prove the equality between the four algebraic expressions. Some students find it difficult to escape the idea that representations are made **for a particular value a.**

Teaching strategies

- Figurative and evolutionary patterns, rule finding, recursion, generalization, investigation, and reasoning.
- In this figurative regularity, recognizing the structure and explaining it is of a higher level of skill because the relationship is not linear.
- The problem gives rise to work in algebraic calculus to justify the equivalence of the representations proposed by the students.

Strategies	Patterns	Comments
We count the small squares at each step.	The numbers we need to add, to move from one step to the next, are the odd integers greater than 5. Steps: 1, 2, 3, 4, ... Number of squares: 5, 10, 17, 26 +5 +7 +9	With a spreadsheet, for example, we get the number of small squares for a given step.
We identify a structure that includes a large square or rectangular layout.		Proving the equality between different algebraic expressions will make it necessary to use algebraic properties of calculus to transform the expressions (factorization and expansion).

Physics

Activity on Coulomb's law

Pre-activity prediction

Consider that a force F is exerted between two charges q_1 and q_2. If we increase the distance between the two charges, the measure of the force

a) will increase

b) will decrease

c) will not change

Briefly justify your view

……

……

Activity

Open the following link:

http://www.seilias.gr/index.php?option=com_content&task=view&id=74&Itemid=32&catid=20

A. With charge values, q_1 = 1 μC and q_2 = 2 μC, move one or both charges to the distances shown in the table below. For each position measure the electric force and complete the table below

Table 1.

	Distance r (cm)	F (N)
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	

B. Based on the findings from your measurements, is your prediction confirmed or not?

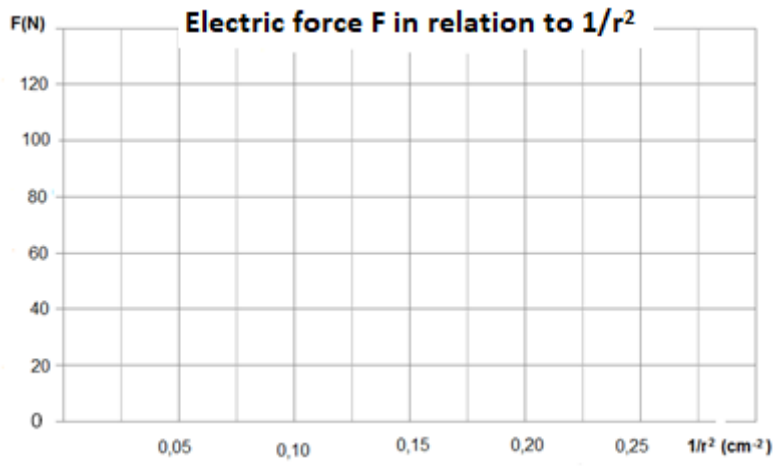
Explain …….

C. Make the appropriate calculations using a calculator and complete the following table.

Table 2.

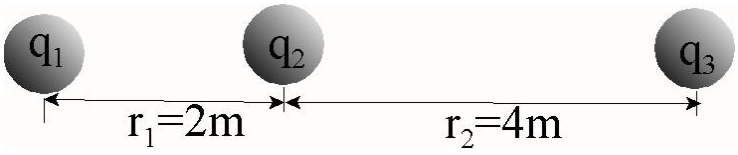
α/α	r (cm)	r^2 (cm^2)	$\frac{1}{r^2}$ (cm^{-2})	F(N)
1	1			
2	2			
3	3			
4	4			
5	5			
6	6			

Draw the graph F=f($\frac{1}{r^2}$).



Conclusion……
……

Post activity task



In the figure above, all the spheres have the same amount of charge. The charges q_1 and q_3 are positive, while q_2 is negative.

a) Plot the forces acting on each charge.

b) If q_2 is left free

A. it will move to the left

B. it will move to the right

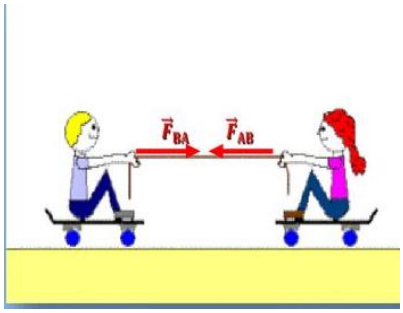
C. will remain stationary

Choose the correct one and explain your choice.

Activity on Newton's 3rd Law

Pre-activity prediction

Two children pull on a rope with two springs with a hook attached as measuring devices.



a) the force the boy receives is greater

b) the force the girl receives is greater

c) the forces are equal in measure

Briefly justify your opinion

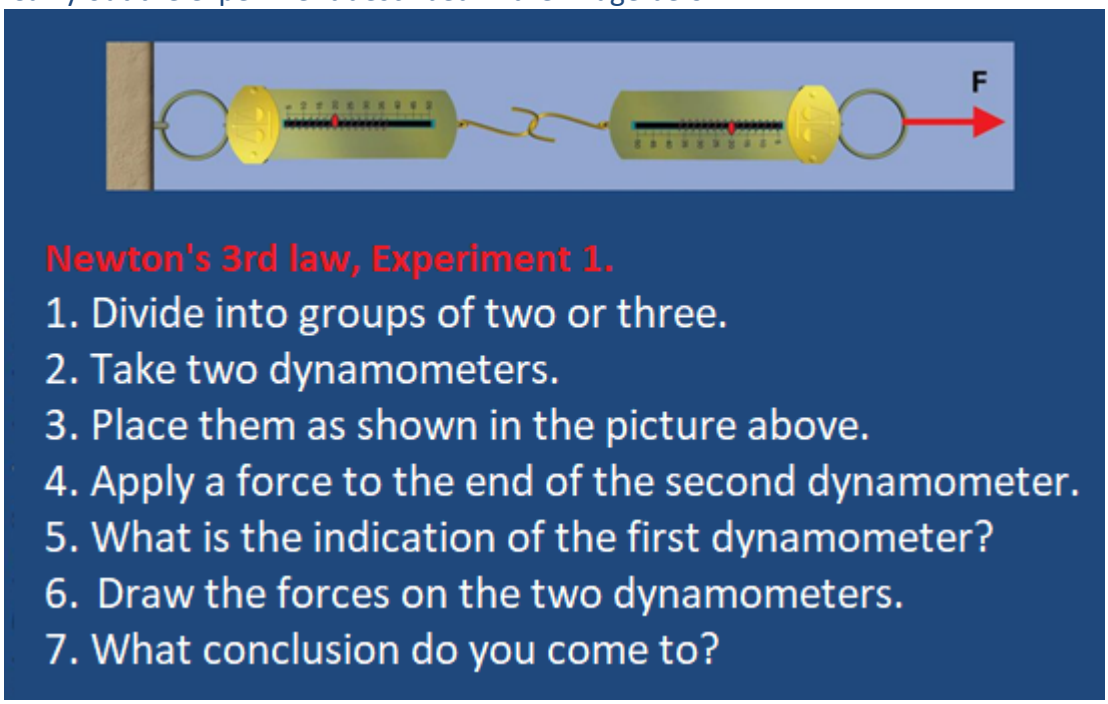
……

……

……

Activity

Carry out the experiment described in the image below:



……

……

……

Alternative activity, in a virtual environment

Click on the link below:

https://www.seilias.gr/index.php?option=com_content&task=view&id=582&Itemid=32&catid=21

In this virtual experiment, there are two wagons in which we can place boxes of different masses. You also can vary the strength of the magnets that cause mutual attraction between the wagons. Once you are familiar with the application, set the power of magnet 1 to be twice that of magnet 2, and by varying the masses, complete the table below:

Table 1. The power of magnet 1 is twice that of magnet 2

α/α	Wagon mass 1	Wagon mass 2	F_1	F_2
1	*1*	1		
2	*2*	1		
3	*3*	1		
4	*2*	3		
5	*1*	3		

Then reverse the power of the magnets and complete the table below.

Table 2. The power of magnet 2 is twice that of magnet 1

α/α	Wagon mass 1	Wagon mass 2	F_1	F_2
1	*1*	1		
2	*2*	1		
3	*3*	1		
4	*2*	3		
5	*1*	3		

What do you observe? To which conclusion do you arrive?

……
……
……

Post activity task

Is the horse right? Explain your opinion

Phase A activity: Exploring sound

Expected learning outcomes	Activities	Materials/Tools	Time
Raising interest in sound and its characteristics. • Explain that the sense of sound is caused by vibrations. • Identify the characteristics of sound: volume and pitch.	Activities 1A, 1B, and 1B′. Study the characteristics of the sound produced by stretched rubber bands.	Activities 1A, 1B, and 1B′. • 1 container (wooden or plastic taper type) • 2 common rubber bands • 1 small thin wood or two small hard business cards joined together.	30’

Activity 1A: Vibration and sound

Attach one end of the rubber band to a fixed point, e.g. the handle of a drawer, and pull the other end of the rubber band so that it stretches enough. Pull and release one side of the rubber band sharply.

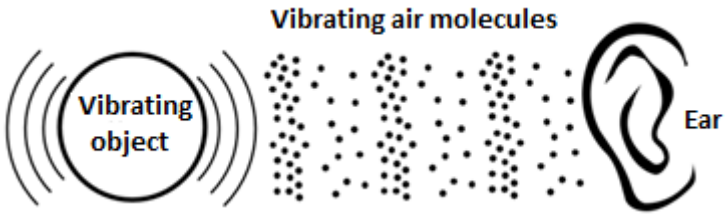
Question 1: The sound produced is loud or faint;

……

Question 2: How do you think the energy emitted by the vibration of the rubber band reaches our ears as sound?

……

……



Activity 1B: Changing the volume and pitch of the sound

In a container, attach two different rubber bands, as in the picture on the right.

α) Pull a little and leave one rubber band.

Question 3: The sound you hear, compared to the sound of activity 1, is different. Which features of the sound have been differentiated?

……

……

Question 4: Can the presence of air under the rubber bands play a role in the change in sound characteristics?

……

……

b) Pull enough and leave the same rubber band.

Question 5: Is the sound you hear, compared to the sound of the previous pull, different? In what way?

……

Question 6: Do you think the loudness of the sound is related to the amplitude of the vibration caused?

……

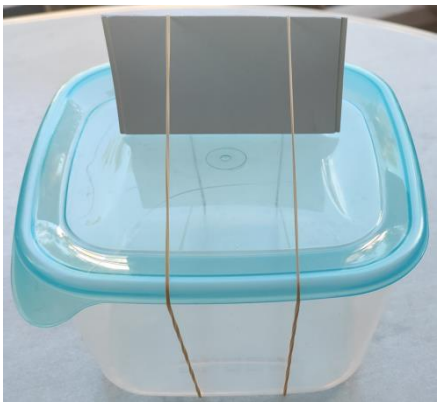
c) Pull a little and release one rubber band.

Question 7: Is the sound you hear now, compared to the sound of the other rubber band, different? In what way?

……

Alternative activity 1B΄

Make the following construction. In a container such as the one in the figure, attach two non-identical rubber bands. About a third of the way down the container, place the two cards upright and slip the rubber bands over them, which should be relatively taut.



α) Pull and release one side of one rubber band very quickly.

b) Pull and release the other side of the same rubber band or the other rubber band.

c) Move the position of the cards forward or backward and pull again the rubber band.

Write down your observations.

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If there are any questions, write them down so that we can discuss them in class.

Phase B activity: Exploring sound

Expected learning outcomes	Activities	Materials/Tools	Time
• Describe how sound waves are produced and propagated. • Relate the intensity and pitch of the sound to the amplitude and frequency of the vibration.	Activity 2A: Watch a video that clearly shows the vibration of the strings of a guitar as they produce sounds. Activity 2B: Study of a simple simulation for sound waves. Announce the findings of each group and discuss them in plenary.	P/C or tablet	10’ 15΄ 15΄

Activity 2A:

Watch the video: The Physics of the Guitar! In particular, observe the vibration of the strings. https://www.youtube.com/watch?v=RNt8d6vJj8c

To record the vibration you see in the video (so that it can be perceived by the human eye), a camera was used that takes 60 frames per second.)

Question 1: Is what happens to the guitar strings similar to what happened to the rubber bands in the experiments we studied at home?

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Question 2: What characteristic of the vibration/oscillation of the string do you think is related to the intensity of the sound we hear from it?

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Question 3: Why does the pitch of the sound change when we change the chord?

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Activity 2B

Study the simulations

a) The sound wave.

http://photodentro.edu.gr/v/item/ds/8521/11356

β) Visualizing Sound in a Medium.

https://openscied-static.s3.amazonaws.com/HTML+Files/openscied-sound-interactives-master/sound.html?version=v4

Question 4: Fill in the blanks in the sentences with the appropriate words:

α) Sound waves are ..... (transverse, longitudinal).

b) Sound waves propagate ..... (in materials, in vacuum).

c) The number of oscillations an air molecule makes in 1 second is called ..... (period, frequency).

d) The time it takes a wave to complete a cycle is called ..... (wavelength, amplitude)

Question 5: The energy from the vibration of the rubber band (which we did in the activity at home) or the string is transferred to our ear:

α) Because it creates compression and rarefaction patterns that propagate through the vacuum.

b) Because it pushes air molecules towards our ear.

c) Because it causes the air molecules to oscillate and this oscillation is propagated through space.

Choose the correct sentence and explain your choice.

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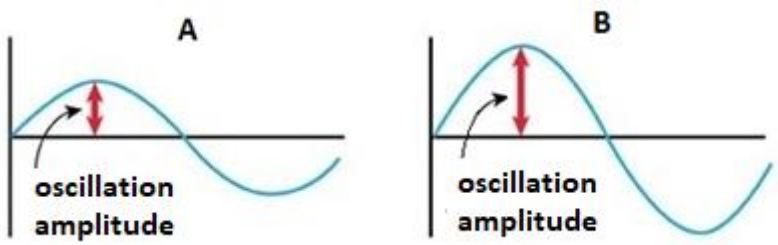
Question 6: The diagrams below show two different sound waves. Which one corresponds to a louder sound?



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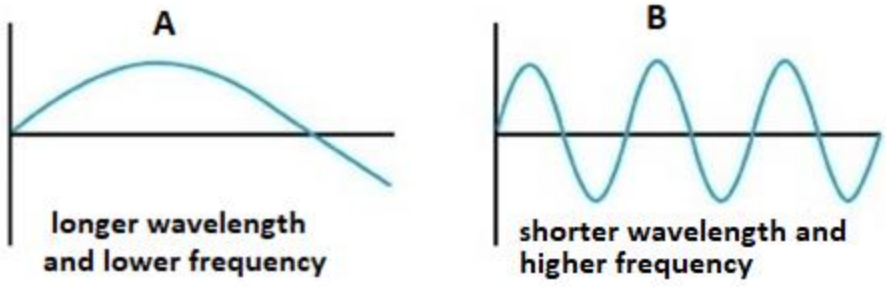
Question 7: The graphs below show two different sound waves. Which one corresponds to a sharper sound (a higher pitch sound)?



Foreign Language

Think-Pair-Share (Hetika et al., 2017)

Creator	Eftihia Papahristou
Course	English
Didactic unit	Graffiti versus Street Art
Estimated Time	15 minutes
Learning objectives	**Think-pair-share** is a **collaborative learning strategy** where students work together to solve a problem or answer a question about an assigned reading. This strategy requires students to **(1) think individually about a topic or answer a question, and (2) share ideas with classmates**. Discussing with a partner maximizes participation, focuses attention, and engages students in comprehending the reading material. **Why use think-pair-share?** • It helps students to think individually about a topic or answer a question. • It teaches students to share ideas with classmates and builds oral communication skills. • It helps focus attention and engage students in comprehending the reading material.
Target Group	C Class Students of Junior High School
Description	**Think-Pair-Share/Write-Pair-Share** • The teacher poses a question that demands analysis, evaluation, or synthesis.

	• Students take a few minutes to think through an appropriate response. • Students turn to a partner (or small groups) and share their responses. • Take this a step further by asking students to find someone who arrived at an answer different from their own and convince their partner to change their mind. • Student responses are shared within larger teams or with the entire class during a follow-up discussion. **How to use think-pair-share** Decide upon the text to be read and develop the set of questions or prompts that target key content concepts. Describe the purpose of the strategy and provide guidelines for discussions. Model the procedure to ensure that students understand how to use the strategy. Monitor and support students as they work through the following: **T : (Think)** Teachers begin by asking a specific question about the text. Students "think" about what they know or have learned about the topic. **P : (Pair)** Each student should be paired with another student or a small group. **S : (Share)** Students share their thinking with their partners. Teachers expand the "share" into a whole-class discussion.

Jigsaw (Mengudo & Xiaoling, 2010)

Creator	Eftihia Papahristou
Course	English
Didactic unit	Graffiti versus Street Art
Estimated Time	15 minutes
Learning objectives	**Jigsaw** is a **collaborative learning strategy** that enables each student of a "home" group to specialize in one aspect of a topic. Students meet with members from other groups who are assigned the same aspect, and after mastering the material, return to the "home" group and teach the material to their group members. With this strategy, each student in the "home" group serves as a piece of the topic's puzzle and when they work together as a whole, they create the complete jigsaw puzzle. **Why use jigsaw?** • It helps build reading comprehension. • It fosters collaborative learning among students. • It helps improve listening, communication, and problem-solving skills.
Target Group	C Class Students of Junior High School
Description	**How to use a jigsaw** Introduce the strategy and the topic to be studied.

	Assign each student to a "home group" of 3-5 students who reflect a range of reading abilities. Determine a set of reading selections and assign one selection to each student. Create "expert groups" that consist of students across "home groups" who will read the same selection. Give all students a framework for managing their time on the various parts of the jigsaw task. Provide key questions to help the "expert groups" gather information in their particular area. Provide materials and resources necessary for all students to learn about their topics and become "experts."

Digital Escape Rooms

Creator	Eftihia Papahristou
Course	English
Didactic unit	Graffiti versus Street Art
Estimated Time	15 minutes
Learning objectives	**(Digital) Escape rooms** are a **collaborative learning strategy** that can be a fun, exciting way to unlock a mystery collaboratively. In physical escape rooms teams work together to solve various clues and unlock codes so that they can essentially escape the room. Escape rooms can be engaging active learning activities that allow students to review course concepts with their peers during class. Escape rooms can translate well into virtual, synchronous settings by building them in a tool such as Google Forms and assigning students

	to specific groups or breakout rooms to solve the clues. **Why use Escape rooms** An escape room is a critical-thinking adventure game. Participants work together to solve a series of puzzles, riddles, and physical challenges to unlock a door. Teachers can craft their challenges to raise students' motivation to participate in the activity.
Target Group	C Class Students of Junior High School
Description	**How to implement Digital Escape Rooms** See the 10-step process below presented by Neumann et al. (2020, p. 420-421) to understand how Digital Escape Rooms can be implemented: 1. Determine which group of students you are creating the digital escape room for, the length of time you will give students to complete the escape room, your intended level of difficulty, the topic(s) to be covered, and learning objectives. 2. Create a list of the 3-5 most important takeaways from the topic your digital escape room will be covering. 3. Write one question for each important takeaway that would encourage students to demonstrate and/or apply what they have learned. 4. Write a background story that provides the context or theme for the room or environment your students are trying to escape from. Hide clues in the background story that presents the first puzzle students need to solve to unlock the first lock. 5. Find or create an image of the "room" or environment students will be escaping from. In step 7, you will hide links to additional puzzles that assist students in unlocking other locks.

	6. Create puzzles for the remaining questions you wrote in step 3. Consider using the provided puzzle resources to assist you in creating the puzzles. 7. Hide the links to each puzzle you created in step 6 in the image of the room or environment students will escape from. 8. Create a form for students to submit their puzzle solutions and unlock each of the locks. If possible, create a section for each lock and require response validation for a text that contains only the answer; this will prevent students from moving to the next lock before they have submitted the correct response. 9. Compile your background story, room/environment image, and form in a single location for students to access and complete. 10. After implementing, evaluate the learning objectives, get feedback from students about their experiences, and update the digital escape room as necessary.

Fishbowl Strategy (Pearson et al., 2018)

Creator	Eftihia Papahristou
Course	English
Didactic unit	Graffiti versus Street Art
Estimated Time	15 minutes
Learning objectives	**Why use Fishbowl Strategy?** Fishbowl is a collaborative engaging and student-centered strategy that builds comprehension of complex texts while developing group discussion skills. In the inner circle—or "fishbowl"—students practice responding to multiple viewpoints. Observations from students in the outer circle provide insight into what makes for effective small-group discussions. Research supports the use of fishbowls as a particularly effective way to engage students with a range of abilities in multiple settings.
Target Group	C Class Students of Junior High School
Description	**How to Implement Fishbowl Strategy** 1. Choose a text. The text can be read independently before class or in class. 2. Begin by selecting four or five students to join the fishbowl group. Only students in the fishbowl are allowed to talk. 3. Instruct the outer circle to remain quiet, observe and take notes on the content and process of the inner circle's discussion. 4. The first few times, play the role of the facilitator yourself. Once the process is familiar, select a student facilitator. The facilitator does not participate in the discussion but poses questions along the way to prompt

	deeper discussion and to make sure everyone inside the fishbowl has a chance to talk. 5. Identify the focus of the discussion and provide text-dependent questions for students to answer during the fishbowl discussion. 6. Allow the conversation to progress where students take it. Rotate students in and out of the fishbowl throughout the course of the discussion. Set up a procedure ahead of time so students know to expect this rotation. Allow the fishbowl discussion to continue for at least 15-20 minutes. 7. After all students have rotated through the fishbowl, divide the class into small groups and invite students to debrief. Students can use their observations from the outer circle to highlight the strengths of the discussion and make suggestions for ways to engage each other more meaningfully. These discussion starters can facilitate the conversations: ▪ *What did you observe during the discussion of the text?* ▪ *What is one thing you heard that you agree with?* ▪ *What is one thing you heard that you disagree with?* ▪ *How did you feel while on the outside of the fishbowl?* ▪ *How did you feel while on the inside of the fishbowl?* 8. Wrap up the process with a full class discussion. Pose a final question and allow everyone to respond by turning and talking with a partner or doing a quick write: What is one thing you have learned from the fishbowl process about discussing texts? learningforjustice.org/classroom-resources/teaching-strategies/community-inquiry/fishbowl

Tic Tac Toe (Romano, 2014)

Creator	Eftihia Papahristou
Course	English
Didactic unit	Graffiti versus Street Art
Estimated Time	15 minutes
Learning objectives	**Why use TicTacToe Strategy?** Think-tac-toe is a strategy that harnesses the visual pattern of the tic-tac-toe game to broaden student understanding of instructional content, challenge students who already have some mastery of a subject as well as provide a variety of means to assess student mastery in a way that is fun and unusual. A teacher would design a think-tac-toe assignment to support the purpose of the study unit. Each row could have a single theme, use a single medium, explore the same idea across three different media, or even explore a single idea or subject across different disciplines.
Target Group	C Class Students of Junior High School
Description	**How to implement TicTacToe Strategy** 1. There are 1–4 students per team. Two teams play the game, with one team as Os and the other as Xs. 2. The teacher distributes the premade Tic Tac Toe grids, or the students copy them from the board.

3. The teams take turns choosing any square to try to score "3 in a row."
4. The team jointly makes one sentence with the selected grammar or vocabulary.
5. The other team judges the sentence with teacher assistance, if necessary. If correct, the team places the appropriate letter (O or X) in the square. If the sentence is incorrect, the square stays as is.
6. The winning team is the first to get "3 in a row" horizontally, vertically, or diagonally.

1. You can make several grids on a piece of paper and then copy one per team, or you can have the students draw their game boards modeled after your sample on the board.
2. You might want to consider placing more difficult language items in the center row going across the puzzle. That way, for a team to win, they will likely need to get a harder item correct.
3. Suggested grammar forms to use:
    A. simple past irregular verbs (write the infinitive form and a past form needs to be created; e.g., to ask, to believe, to cry, to go, to protect, to sing, to talk, to wish, to give)
    B. adverbs or adjectives (use one part of speech and the other needs to be created; e.g. slow, quick, happy, bad, fast, sweet, silent, angry, extreme)
    C. verbs followed by gerund or infinitive (write the verb and a second verb in the infinitive or gerund form needs to be created; e.g., start, stop, try, begin, dread, forget, keep, need, regret, remember).
    D. You can also use vocabulary from any text the students are studying, interested in, or learning.

Foreign Language (French)

Resembling the "Millionaire Game"

Creator	RDPSE of Attica Stelios Markantonakis
Course	French
Didactic unit	Speaking about myself (linguistic knowledge)
Estimated Time	30 min
Learning objectives	Vocabulary and syntax
Target Group	LEVEL A1
Description	This game activity resembles the well-known "Millionaire" Game. It could be exploited to recapitulate what is taught in the didactic unit "Introducing ourselves". The activity could be given as a project where students could create their own question sets. http://photodentro.edu.gr/ugcc/Franconnaire1_pidx006839

10 Appendix B: The "Reflection Diary" Template

The reflection diary template is presented in a "Google Form" format:

1. Have you applied an existing scenario or created by your own? *

Long answer text

2. Give a short description of the scenario *

Long answer text

3. Give details of each phase of the Flipped Classroom (Before Class, In Class, After class), as there is in the scenario *

Long answer text

4. How easy was the implementation of the scenario to the students? *

- ○ Extremely easy
- ○ Very easy
- ○ Moderately
- ○ Slightly easy
- ○ Not at all easy

5. Were there any problems or difficulties in implementing the scenario? *

- ○ Yes
- ○ No

(5a) If yes, please describe them

Long answer text

6. In a few words, indicate the reverberation of the piloting at students. *

Long answer text

7. In a nutshell, explain how the pilot contributed to your professional development. *

Long answer text

8. Indicate some changes in your typical instructional approach that the pilot helped you make.

Long answer text

9. Identify some critical didactic incidents that you used in your instruction. *

Long answer text

This template indicates that a typical reflection diary could include questions revolving around the below topics:

- Easiness and success of implementation.
- Implementation reverberation at students.
- Problems encountered during implementation.
- Changes in the typical instructional approach.
- Critical didactic incidents.
- Professional development.

As it is explained by the questions of the “reflection diary” template, a typical reflection diary aspires to help educators to:

- Evaluate their teaching methods.
- Indicate changes in their instructional model.
- Exploit the competent tool of critical didactic incidents.
- Increase their teaching implementation reverberation at students.
- Secure their professional development.

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