Part 2: How to integrate ER in the school curricula (+/- 8 pages)

2.1. Defining the objectives of the Escape Room starting from the school curricula

2.1.1. Theoretical overview

In recent years, changes in curricula have been taking place in all education systems in Europe. Priority is given to STEM training and the development of new curricula. Their development is based on the understanding that the impact of globalization and the need for a sustainable future are reshaping the foundations of school education.

In today's society, the skills and competencies required for students to succeed in society and working life are also changing dramatically, and therefore the education, pedagogy and role of the school itself must change because of the dynamic global changes.

The curriculum introduces multi-literacy in teaching and learning. The increased need for many and interconnected competences arises from the changes in our surrounding world. In order to meet the challenges of the future, emphasis is placed on intercultural and diverse competences, as well as on cross-curricular links. As the structures and challenges of "doing", knowledge and being change significantly in our society, it requires us to have comprehensive knowledge and capabilities. The need for systemic change is defined, whereby the entire education system and school culture are reformed to fit the modern teaching concept. The major changes are made on the basis of a new curriculum.

The most influential philosophical doctrine in education in recent decades is the **constructivism** most commonly associated with Dewey, Piaget, and Wiggotsky (Toshev, 2012). It aims to build knowledge, develop skills in learning based on output. The training is person-oriented, based on real-world learning tasks and is seen as a joint activity between the teacher and the learner. A prerequisite and condition for success is the social skills of those involved in the educational process. The essence of the doctrine is related to the understanding of the nature of human knowledge and the learning process, as well as to the conditions that may have an impact.

The basic idea is that people are not passive recipients of information, but actively and selectively construct their own knowledge by linking existing knowledge and experience to new information gained through active purposeful and deliberate activity, by solving real-world tasks and collaborating with others.

The teacher is not only a source of knowledge, but also a leader, a facilitator, a consultant, a partner, who helps students formulate their own ideas, opinions and conclusions.
Constructivism is a theory of learning and determines the nature of learning and the most appropriate conditions for knowledge. The learners themselves relate the new information to previous experiences and create knowledge through actions aimed at personal and social transformation. Social connections and interactions are also a source of knowledge.

The learning environment represents the natural complexity of the real world, taking into account the impact of various factors: culture, technology, learning process. The tasks are real and have contextual significance.
The **role of learners** in learning is related to their individuality, learning motives, interests, personal choice, social connections and interpersonal relationships.
The **role of the teacher** is to structure information about learning problems, to organize situations of doubt, to assist students in understanding new knowledge and integrating it with previous ones. Ideas are presented synthetically, and students are encouraged to seek answers and solutions, to ask, to make experiments, analogies and conclusions. Individual knowledge is the result of constructing meanings and interpretations gained from the student's experience, of questioning and analyzing tasks, of finding one's solution to the problem. Regardless of the different interpretations, it is accepted that the constructivist model of training is characterized by the construction of its own knowledge, which depends on the available knowledge and experience. Interaction has a decisive role in cognition and requires real learning tasks to be solved.
The learning environment reflects the **interaction between teaching and learning** in the didactic process. It has **psychological and didactic characteristics**. The psychological are related to the approach to learning, the teaching style, the climate of interaction between the learner and the didactic - to the technologies of teaching and learning.
Constructivism is the methodological basis of the concept of active learning and its variants:

- learning by doing,
- learning by acting,
- self-learning,
- contextual learning,
- problem-oriented learning,

- project-oriented learning and
- learning through interaction and collaboration.

What they have in common is **solving real problems**, taking into account the individual differences of learners - learning styles, motivation.

The created interactive learning environment expands the opportunities for social interaction and cooperation and allows freedom of choice and expression for every student.

The new knowledge is integrated into already existing structures; the experience gained is applied and tested in new situations. The success of this training depends crucially on the competence of the teacher, as he or she organizes independent cognitive activity.

Problem oriented learning - Critical Thinking, Multilevel Thinking and Motivation

Learning, in terms of constructivism, is based on the active involvement of learners in critical thinking, problem solving, finding meaning and understanding.

According to K. Rogers, learning proceeds optimally when learners are fully **involved** in the learning process and exercise control over its nature and direction. Learning is based on the **confrontation with practical, social or research problems**.

Self-assessment is a principle method of assessing learning progress and success. These are some of the **characteristics of constructivist training**, which are the hallmarks of problem-oriented learning.

The basis of knowledge is **critical thinking, understanding, and self-control**. In solving the problem, students acquire knowledge, skills and experience in gathering the necessary information.

As a result of **self-study**, they learn how to do it themselves and apply it to specific real-life situations.

Educational goals are set, activities are organized, problems are discussed, and hypotheses are generated. The results are presented and discussed in class. The training process, problem solving and teamwork are commented on.

Understanding science is essential in today's society. People's understanding of science is greatly influenced by classroom experience. This is why it is important for science teachers to understand science and recreate an accurate picture of it. Science is a **collection of knowledge**; it involves both the **research process** and the people involved in the scientific activity. Science teachers typically focus on knowledge that encompasses their discipline.

However, students also need to understand the **process of scientific inquiry**. Such an understanding should be gained from experience in the classroom and outside the school. **Problem solving** involves cognitive activities that the learner performs when seeking to achieve the desired goal. This is not an ability that some students possess, or a skill that someone will acquire quickly, but is practiced and developed in the classroom. It is a process that depends on existing knowledge and skills to work independently and work in a team. Resolving the problematic situation requires an active search for the path through the application of knowledge, strategies, heuristics, interaction and mutual assistance. **Problem training** implies an emphasis on both the process itself and the product or solution. This **process is conscious**, purposeful, because the learner strives to reach the desired end state, which satisfies him. The criteria for achieving the ultimate goal are efficiency, effectiveness, applicability.

Problem tasks differ in their structure, complexity, dynamism and specific area. Depending on the type, different skills, approaches and processes are applied to solve them.

They can be classified into well-structured, medium-structured, and poorly structured problems. **Well-structured problems** are those where there is a great deal of certainty because all the information is present. Procedures and algorithms are used to reach a decision. The main characteristics of well-structured problems relate to a well-defined initial and final state, availability of internal and external resources, and a correct answer. They imply the application of a limited number of rules and principles, which are organized in a pre-established order. These types of problems include concepts and rules that are well structured and have known and accessible solutions (Jonassen et al., 2003).

Problem-based learning is distinguished by a wide variety of titles. It can be called "problem-based learning", "problem-solving learning", “problem oriented learning”, “problem-situational training ", "didactic problems", etc.

The main features of problem-based learning are the following:

- The educator is a facilitator, assistant, partner in the process of solving problems;
- it draws students' attention to a particular learning problem, to which they seek a solution known in advance;
- if deviations from the final decision are made, timely adjustments are made, with the teacher pointing out new facts or arguments;

- situations are created which lead to the students' belief that they themselves discover the truth, the decision, the fact, but in reality it is considered "staging" the research process;
- in the process of study, students collect information, check, suggest solutions, evaluate, conclude, summarize, with a high degree of autonomy, strong motivation and activity throughout the learning process;
- creative thinking is related to the contradiction between what is given and the search; (Andreev, M., 2001; Vitanov,L., 1999)

According to V.A. Krutetsky, there are three levels of problem-based learning, depending on how the student solves the learning problems.

- the student solves a problem identified and formulated by the teacher;
- the student formulates and solves a problem identified by the teacher;
- the student independently sees, formulates and solves the learning problem;
- the student sees and formulates the problem but does not solve it (Petrov, P., 1992)

Learning through experience

One of the most well known and commonly cited constructivist theories for learning is **Kolb's theory of learning through experience or experiential learning**.

It reveals the link between the experience, learning and development of the individual and draws the attention of many researchers with its versatility and practical applicability.

Kolb (1984) applies the basic ideas of learning through experience in the context of **lifelong learning** - he substantiates the thesis that learning is a process of **turning experience into knowledge**.

Learning in the Kolb model is a cyclical process that goes through **four phases** that build a complete learning process.

It starts with **involving learners in an activity** to gain a specific experience that provokes an experience, a curiosity, questions that are not answered. A key point in learning is the **reflection of experience**, which requires learners to reflect on their actions and available knowledge in the context of the task. This is done by **discussing the experience** gained in a group, finding alternative solutions, and playing out situations. Important are the language culture, the ability to engage in discussion, and non-standard thinking. Reflection leads to an

abstract conceptualization in which the results are interpreted, regularities are considered, conclusions are drawn, decisions are made.
"At this stage, learning involves logic and ideas rather than feelings for understanding problems" (Kolb, 1984).

2.1.2. Defining the objectives of escape rooms/games

One of STEAM education's priority is to provoke students' interest and to provide an authentic learning experience. According to Reeves et al. (2004), students should have **authentic tasks that have a real-world context**, ill-defined problems, complex or multi-step questions, multiple ways to approach a problem, integrate across the disciplines, and have failure and iterations built into the assignment itself (Armory, 2014).
Many teachers determine the **benefits of STEAM education**, recognizing that the "*design and creativity of the arts are crucial underpinnings of the successful mathematician, scientist and engineer*" (Hogan & Down, 2016, p. 50).
According to Bertrand (2019), a few questions arise:

1) What curriculum and instruction models of STEAM education are implemented in schools?
2) What do students learn through different models of STEAM education?
3) What sorts of assessment of student learning is occurring in STEAM education?
4) How do classroom teachers view such models of STEAM education in meeting their curriculum and instruction goals?

The new changes in society are critical for understanding the emerging trends in education. With the proliferation of data and communication technologies, we face multiple challenges when it involves educators so we must be ready to try new and effective modern teaching experiences and to make the necessary changes to stay up-to-date.
To cope with this new emerging reality, new trends in education are to be experienced and evaluated. Nowadays, we are facing with more interactive and collaborative technological environments (Amberg, Reinhardt, Haushahn & Hofmann 2009).

Escape rooms have already been used in education. An escape room in STEAM is to gather tasks that involve knowledge from several subjects. It is important to have a clear brief, from

the very beginning, that states the age group of the students, the number of students, and the place where the game will be played. When working with an educational escape room, it is important to define as early as possible the educational content the group will face.

In order to do that, teachers should first meet and reach a consensus about several things:

• the age group and educational needs of the students

• the length of experience

• the difficulty of puzzles for different levels of players

• the mode of the escape room: Cooperation based vs Competitive based

• number of participants the game/room is to be designed for

The next step is to develop the objectives of the educational escape room experience. According to Arnab & Clarke, developing the objectives for the game experience early in the design process will ensure that the experience is designed purposefully and that the game theme and puzzles are often developed to reinforce the objectives instead of attempting to embed objectives into an already designed game.

The objective step is presented by:

• ***Learning Objectives***: Learning objectives are required to create a meaningful educational game. These objectives are often worked into the theme, its puzzles and to its chosen mode to assist structure the training plan/outcomes. Creating tangible objectives allows to develop the evaluation strategy to assess players' learning experience, learning achievements, change metrics and can be iteratively redesigned to focus on the desired outcomes of the experience.

The educational escape room can be used in order:

- To provide alternative and exciting ways for learning new knowledge, skills or attitude.
- To test existing knowledge/skills/understanding/growth level.
- To link knowledge to multisensory, effective, active and\or practical memories.

The educational escape room is built to learn with various but specific learning objectives:

- To learn something concrete (subject, topic, empathy, social skills, and knowledge).
- To increase self-esteem and awareness, social interaction.
- To understand what role best fits in the team.
- To open the mind and look at things and situations from different perspectives.
- To use what is already known for a different purpose.

- To apply existing knowledge or skills.
- To create awareness of the attitude and behaviour of learners and the effect of that on themselves and others in the group.

• ***Solo/Multi-Disciplinary***: The escape room can be created to solve problems specific to one subject, or to a group of subjects such as STEAM. It can be valuable to bring students together to explore problems from different viewpoints.

• ***Soft Skills***: Interactive live-action games are by their very nature, great tools for helping to develop soft skills such as communication and leadership. One method could also be to run the experience across multiple rooms, with the answers split between them. The only way to solve this type of game is for players to speak their surroundings to the opposite room and the other way around.

- *Social Skills*. Escape rooms offer the opportunities for groups of students to work together to solve puzzles, gaining the benefits of knowledge and insights from others.
- Good escape rooms are designed in such a way that they cannot be solved alone (for example they need two people in different spaces to solve a code) so that players have to communicate and collaborate in order to solve the puzzles.
- *Lateral thinking*. Many of the problems and puzzles that players face in escape rooms require them to think differently from their usual mindset and combine objects and ideas in novel ways. This type of thinking is an important underpinning to creativity and innovation.
- Time management is also at stake in a time-based challenge. Together with collaboration, this can promote overall personal resource management.

• *Problem Solving*: Develop problem-solving challenges to make the game experience interesting to players. A range of challenges will be attractive to different learner types. Challenges might be physical (think checking out an item), intellectual (i.e. algebra or math's puzzles), or many other variations.

- Escape rooms present a variety of different types of puzzles from codes and ciphers and traditional puzzles, to finding or manipulating objects and complex digital puzzles. Players are presented with a variety of problems that they have to solve, gaining skills in thinking through problems and developing approaches to solve them.
- Players also develop resilience as they make multiple attempts to solve puzzles in different ways, and creativity as they come up with different novel solutions.

Following this step should provide a foundation in which it is clear what the objectives are that the intended game is trying to achieve with the participants. This will also provide a basis for developing the evaluation strategy later on in the design process and will help the debriefing stage.

2.2. Defining the content/materials introduced

The basic objective of an escape room/game is **to assimilate content** in a modern and different way so that knowledge is better comprehended. The escape room will lead students to the previous knowledge already acquired in lessons or will help gain knowledge, skills and competences in an innovative way. That will follow one of the principles of the scaffolding strategies, that is, tapping into prior content areas and connecting it to the future (Alber 2014). Therefore, such an escape room can be used as a way to revise for a possible exam or for introducing a new unit/chapter using already studied content.

Teachers meet in order to reach **a consensus about the scope** and the **different activities** that students will have to carry out in order to escape from the class.

On the one hand, teachers will have to decide **the type and number of assignments** depending on the length of their escape room. On the other hand, they have to bear in mind **materials and places for these tasks**.

Some of the ideas for the elaboration of this escape room include puzzle, locks (directional, alpha, digit, etc.), decrypt messages, hidden objects, searching for items in odd places, searching for objects in images, lights, pattern identification, black light pens, riddles, ciphers without a key, secret codes, sounds, mirrors, abstract logic, lockable containers or zippered pouches, research using information sources, mazes, physical agility, UV flashlights, shape manipulation, magnets, piece together parts, smell or taste, etc. Some of these ideas have been extracted from Nicholson (2015).

It is significant that educators know the level of their students in every subject. Accordingly, **the tasks should be challenging** but achievable. If assignments are too difficult, it could be counterproductive and students can be disappointed.

In this step a first teachers meeting will be held in order to **establish the main topic** of the educational experience through a brainstorming of ideas. A further meeting will **set the content** that is going to be studied / revised **and activities** with a more detailed description.

After identifying the educational goals and available resources, comes a crucial step: **creating a STORY** for the room. You have to create **a narrative** about what is going on in this room and what the learners need to do.

In this step, **players' motivations**, **game story** and **content** is considered to bring about an amazing game experience for the students. Popular themes such as; detective mysteries, prison breaks, escape the kidnapper, spy/espionage games etc. are used to build believability of the game experience using a range of decorations and props, lighting, music, puzzles and riddles and clues that follow the theme of the room. This step has been informed by the work conducted by Nicholson. The theme step is split into four areas for developers to consider in their design process.

- Escape Mode: Escape a locked room in a set time.
- Mystery Mode: Solve a mystery in a set time.
- Narrative Design: Develop a compelling narrative for the game to keep players' interest.
- Stand-alone/Nested: Determine whether the game is a one-off experience or part of a larger, nested experience in which several games can be designed and played.

Within the four steps, the developers are asked to consider the composition and narrative structure of the game so that players can identify with the game experience and build personal motivations to complete the game.

The escape room aims to utilize learners' potential by **addressing different skills and competences** and at the same time be **relevant to the content/ theme** of the game. Tasks should respond to different learning styles, qualities and personalities. Elements that contribute to learning, understanding, remembering, creating awareness and personal growth are:

- use of pictures;
- use of pieces of text and information in order to understand it and come up with the answer;
- use of quotations/ facts and need to structure them and put in order;
- logical thinking tasks;
- creative thinking tasks;
- chemical, biological, physical related tasks;

- lateral thinking tasks that force the participant to understand and escape from their own box;
- possible tasks that are not mandatory for solving the room and exit, but those tasks are exciting and useful for learning objectives

2.3. Creating the context + coherence

It is relatively easy for teachers to define good teaching goals and to find a narrative scenario. Designing a game-flow instead is less common: in an escape room it is a matter of designing the puzzle sequence that players would have to solve to get out of the room. Escape rooms could have a predefined sequence (sequential game) or a more flexible one (open sequence), or even hybrid solutions with more paths (Nicholson, 2016). Teachers also need to consider whether there is something for everyone to be doing during game play. This will depend on the degree to which the puzzles are open or sequential.
An entirely open game may lack narrative flow, while a sequential one may leave some players on the sidelines. A balanced combination of different parallel paths provides a solution, but needs careful testing to ensure that all paths are with the same degree of difficulty.
After creating the story for the room, the teachers should use their creative thinking abilities to figure out the TASKS (games, puzzles, riddles…), each kind of challenge inside the room that learners will have to solve in order to advance forward in the escape room and get closer and closer to the final goal.
Each task should reveal some information, provide a guideline, or key that learners will use afterwards. Those tasks are also the opportunity to **link the room with the educational goals**.
The tasks should be **designed** according **to different competences and abilities of learners**; not all of them should require only logical, digital, or mathematical challenges. The tasks should be solved using **different perspectives**, ensuring that **all learners are included** as each one can bring to the common goal something different but equally needed.
All exercises and assignments must be prepared and placed in advance. It is important to have **a system to check the game-flow** of the room, the puzzles and their order, and the key objects that the players need to interact with. A simple way to do this is by creating a

room map - this details each individual puzzle and provides a memory aid to where it is located in the room, and visibly shows the flow of the room in terms of the order in which the puzzles must be completed.

A **room map** is useful for **checking for consistency** in the room design, sharing the design with others in the design team, and acting as a key to re-setting the room once it has been played.

It also provides an overview of the room and enables to consider the **game balance**:

- Have you included a range of different types of puzzles?
- Have you included a range of different difficulties of puzzles?
- Have you used a variety of different types of lock, such as physical (padlocks, keys), mechanical (magnets, weights, gears), and electronic (computer passwords)?
- Are there many different things for people to do (e.g. searching for objects, solving puzzles, opening boxes)?

It is also important to consider how to **integrate the narrative into the game** - will it be the key to solving the puzzles or simply add to the atmosphere of the game. Teachers need to think creatively about how to bring the narrative into the game from initial briefing through to the end game. Teachers also need to think about the finish of the game - what is the object from the students' perspectives and how they can make it as satisfying as possible if they achieve it. It might be to escape a room, but could involve defusing a bomb, or solving a mystery. Again, tying this together in a **coherent narrative** can significantly add to the players' enjoyment of the game.

As with all aspects of the game, it is important to **test each puzzle individually** with as many people as possible. Consider:

- Is it clear? Do the players understand what they have to do? Are there other possible interpretations of the instructions?
- Does the puzzle assume some prior knowledge? Can you make this available in some form?
- Is there only one solution, and is it obvious when the correct solution has been found? This is a very important point: nothing is more frustrating than finding out a puzzle has been solved on the first try without even realizing!

Once there is **a plan** and the basic **individual puzzles** that form the game, the teachers can **bring them all together**. Testing at this stage will enable teachers to discover whether they have the **right balance of playability and learning**, and give them the opportunity to refine existing puzzles or add new ones. At that time, supplementary elements (secrets and surprises that add an extra level to the game) can be put in.

The next thing to think about is the **necessary equipment** to make the puzzles work and to **set the scene**. Consider:

- *Staging and props*. What can be added to the room so that it fits in with the theme?
- *Lighting and sound*. If there is control over the light, how will it be set? Will there be music playing?
- *Backstory*. Are there additional elements that fit in with the narrative and provide colour through a backstory?

Testing of the escape room **at all stages** is crucial in order to develop a game that is both **educational** and **fun** to play. A self-evaluation checklist tool can be used to guide testing.

2.4. Tools to integrate content; Visuals, Apps, …

Developing the puzzles and activities that the players will interact with during the game experience is a very important stage in the overall design of the escape room. This step has been informed by the work conducted by Nicholson.

- *Puzzle Design*: Puzzles and riddles should be diverse, challenging and adapted to fit learning objectives.
- *Reflect Learning Objectives*: Refer to proposed learning objectives and theme to ensure that puzzles reflect the overall goals of the learning experience.
- *Instructions/Manuals*: Clear instructions and explanations are of major importance to help guide players.
- *Clues/Hints*: Escape Rooms are notoriously hard. Insure clues are available and the method of delivering these clues to players in the game does not break player immersion.

Ensuring that the puzzles accurately reflect the objectives set previously in the design process will allow for easier validation and assessment of whether the objectives have been achieved at the end of the game's experience. It is also useful and an essential part of

escape rooms as noted by Nicholson, that the developers provide players with clear instructions and have a plan for providing clues when/if players get stuck whilst playing through the game.

Most Escape Rooms have levels of difficulty ranging from beginner to intermediate and finally landing on expert. Depending on the group, you will want to puzzle the group but not stump them so the puzzles and riddles are nearly impossible to solve.

Create the easiest puzzle first and increasingly make the tasks more difficult. You will also want to create a wide range of puzzles, clues, and strategies to adhere to the different skills each player will possess. It will get boring if the same person who is great at finding patterns for codes is used over and over again.
A possible example for designing the assignments for the escape room:

- Choose 6-9 puzzles for an hour-long experience. Puzzles might be things like substitution ciphers, visual images, word puzzles, word searches, or logic puzzles.
- Divide students into teams of 4-8 people.
- Use Google Forms as the basic "progress meter": this is where each puzzle is presented, the answer is typed in, and the next puzzle is revealed with the instructions to make the next handout actionable. Every subsequent puzzle will need a correctly spelled answer in the Google Form to advance to the next screen, which provides the needed clues to solve the next puzzle, and so on until the end.
- Each team gets an envelope with all the puzzles as the game begins. While the handouts are all present at the start of the game, none of them make sense at the outset until the first puzzle is solved. Each subsequent puzzle only makes sense as the last one is solved, because it provides a necessary clue in the introduction of the next puzzle.

Another important step in designing the escape room is the location/equipment that should be used to support the game experience, informed by Nicholson’s work. If the design of the game is to be supported with technology, this step can be useful to consider and plan for how the players are going to interact with that technology and what to do if the technology fails.

- *Location/Space Design*: Ensure enough space for the game experience and that it is comfortable to move around. The environment should reflect the theme as realistic as possible within means.
- *Physical Props*: Puzzle props, red-herrings + general environment items, these are needed to make a compelling and workable experience.
- *Technical Props*: Use technology to enhance the game experience.
- *Actors*: Real-life actors can help concrete the experience further as believable. Actors can also be used as timer indicators or can give out hints if they see the players are being stuck.

This step is used to bring animation to the game experience in terms of providing a life-like or believable setting for the players to interact with.

2.5. Debriefing to link to the school curricula's requirements

It seems appropriate to mention that the ability to make judgments has recently become a major issue. It refers to the ability to analyze and evaluate information and make a reasoned decision, which will empower students' critical thinking. By groups, students will have to assess two dissimilar aspects. On the one hand, students will have to value the escape room itself. They have to learn to make constructive comments that could help teachers to improve their work. On the other hand, they will have to evaluate themselves as a group. Students must be aware that what a person in a group does might affect the rest of their partners.
The power of the escape room experience often lies in **the debrief**. The teachers should set aside at least 10-15 minutes to allow students to talk about the experience. It is recommended having students explain each of the puzzles, and after discussing what teachers observed. Pointing times when teachers saw communication really fall apart, or when they thought students were on the same page, is a great way of having students understand where their strengths and gaps lie.
What about learning? Every task should be linked with the story and provide some learning, either from a specific topic or transversal thanks to the game itself (while working in a time, discovering own competences and needs, dealing with time pressure, etc.). Depending on the educational purpose of the room, it may happen that the crucial learning happens after learners have left the room. This is the 'debriefing room'.

The debriefing room could be a neighbouring room/space or can even be in the same room. It is the content and the role of educators that matters more than the space. In the debriefing room, the educator can talk with the team about their experience in many ways: what they have learned or understood, what changes this experience made to them, what their role was on the team, what surprised them, what specific subject material they learned, what would they change, etc.

The debrief acts as feedback on the game from the teacher/game master as well as an explanation of how to solve the puzzles. The key part of the debrief process is facilitating the players into providing feedback on the experience. The debrief process can provide valuable insight into things such as team-dynamics, communication, and different ways players approach problems. The teacher/game-master directs the discussions and asks the students how this can help them move forward with their studies.

At the end, the teachers will have a meeting in order to assess the strengths and limitations of the educational experience. They will use the rubrics completed by students in order to have their point of view.

As a result of our studies of pedagogical scientific literature, we can draw the following conclusions:

1. Game techniques and escape room projects are one of the most current and preferred methods of teaching STEAM subjects;
2. “Escape rooms” are very suitable and are directly dependent on the requirements of modern students for diversifying the process of mastering complex STEM disciplines;
3. “Escape rooms” are part of the constructivist classroom, problem-based learning, Inquiry Based Learning, Project-based learning and develop the following important skills in students:

- awareness (active listening);
- development of strategies (planning);
- stress management;
- change management;
- criticality and creativity;
- productive collaboration in a group (team);
- self-assessment skills;

- learning skills (laws, theories, concepts);
- time management;
- leadership skills;
- the ability to put yourself in the place of the other (empathy);
- making a decision;
- problem solving

Escape rooms, on the other hand, can help develop problem-solving competencies such as:

- ability to understand the nature of the problem;
- ability to understand the causes, consequences and wider impact of the problem;
- ability to see the problem systematically;
- ability to deal with the problem systematically;
- the ability to use intuition;
- ability to structure the problem;
- the ability to avoid oversimplification and maintain focus;
- the ability to ask questions that would bring us to the heart of the problem;
- ability to adequately evaluate

The organization of the Escape room is an Inquiry Based Learning, which is at the heart of all curricula in Europe.

Table 1 summarizes the main guidelines for STEAM teachers for effective implementation of IBL and for scripting scenarios for an “Escape room”.

What does Inquiry Based Science Learning mean (IBSL)?	
To be taken in consideration:	Teachers' actions are strongly influenced by their perceptions of science. Students' understanding is related to the individual and social qualities of their classmates. Teachers' actions are strongly influenced by their relationships with students
Encouraging, developing and strengthening the links between formal and non-formal learning	Organization of educational activities outside the classroom, in scientific and research centers. • Demonstrating "How Science Works" and "How Scientists Work." • Finding opportunities to demonstrate the "Nature of Science" and introducing students to the culture of science. • Collaboration with museums and general education programmes.

methods through:	• Linking the theme between museum exhibitions and curricula.
Inquiry Based Science Learning means (IBSL):	
Mastering learning through research in a science based on:	• Surveillance: accurate observations; note taking; compare and contrast. • Dialogue: asking questions about observations; asking research-stimulating questions. • Hypothesis formation: hypothesis generation according to available observations. • Research: planning, conducting, measuring, and collecting data, managing the experiment. • Interpretation: synthesis, conclusions, models. • Communication: exchange of information with other participants in the educational process: verbally, in writing, with presentations. • Assessment: develop critical opinions based on observations and old knowledge.
In the process of learning through research:	Students perceive themselves as active participants: • They look forward to conducting research. • Demonstrate a desire to learn more. • Seek cooperation with their peers. • Conduct research confidently; demonstrate a desire to work on their ideas, take over risk and exhibit strong skepticism. Students respect the views of other participants: • Accept the "Training Invitation" and readily participate in the research process. • Demonstrate curiosity and reflect on their observations. • Make use of the opportunities given to them to check and stand their own ideas. Students plan and carry out studies: • They come up with ways to prove their ideas. • Plan ways to test, expand, and reject assumptions and ideas. • Thoroughly conduct their research by observing, measuring and recording data.
Mastering the learning through study in science that is based on:	Students communicate using a variety of ways: • Express their ideas in different ways: publications, reports, drawings, graphs, tables and more. • Listen, talk, and share things about science with parents, teachers, and peers. • Use scientific language. • Discuss what they have learned about scientific phenomena and concepts. The students offer their own explanations and solutions to the problems and get an idea of the scientific concepts: • Provide explanations based on previous experience and knowledge gained from the current study. • Use surveys to answer their questions. • Sort the information and decide what is important.

	• They tend to revise their explanations and discuss new ideas in the process of scientific knowledge formation. Students raise questions: • Ask questions - verbally or through action. • Use questions that lead them to research and subsequently to additional questions and ideas. • They like to ask questions and understand that this is an important part of science. The students observe: • They are watching carefully instead of just watching. • Notice details, look for similar examples, discover patterns; find similarities and differences. • Make connections with proven previous ideas. Students are critical of their scientific practices: • Create and use criteria to evaluate their own work. • Promote and enjoy their strengths and identify what they would like to improve. • They discuss their work with peers.
The role of teachers in learning through inquiry:	• The role of the teacher becomes less involved in direct teaching and more in the modeling, guidance, support and continuous assessment of student activity. • The role of the teacher is more complex; it also includes greater responsibility for creating and maintaining conditions for students to form their scientific understanding. • The teacher is responsible for creating and maintaining a learning environment in which students develop their ideas.
The skills that the teacher needs to develop to assist students in learning scientific ideas:	• Model of teacher behavior and skills. Teachers should: • Show children how to use new tools, materials and equipment. • Encourage students to take greater responsibility in their studies. • Helping students build skills in taking notes, documenting and drawing conclusions. Teachers support the learning process. They have to: • To help students formulate preliminary explanations that are subject to change the process of understanding. • Introduce students to the appropriate tools, materials and equipment for the topic. • Use appropriate scientific and mathematical terms. Teachers use many different criteria for assessment. They have to: • Assess what children think and learn and what makes it difficult for them. • Talk to students, ask questions, make suggestions and share ideas with them. • Be available to all children. • Help students move on to the next level of learning with appropriate guidance and encouragement. Teachers help students. They have to:

	• Use open-ended questions to encourage inquiry, observation and thinking. • Listen carefully to students' ideas, comments and questions to help children learn to think. • Offer new things to observe and experiment with and encourage further exploration and thinking. • Conduct and encourage student dialogue.

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