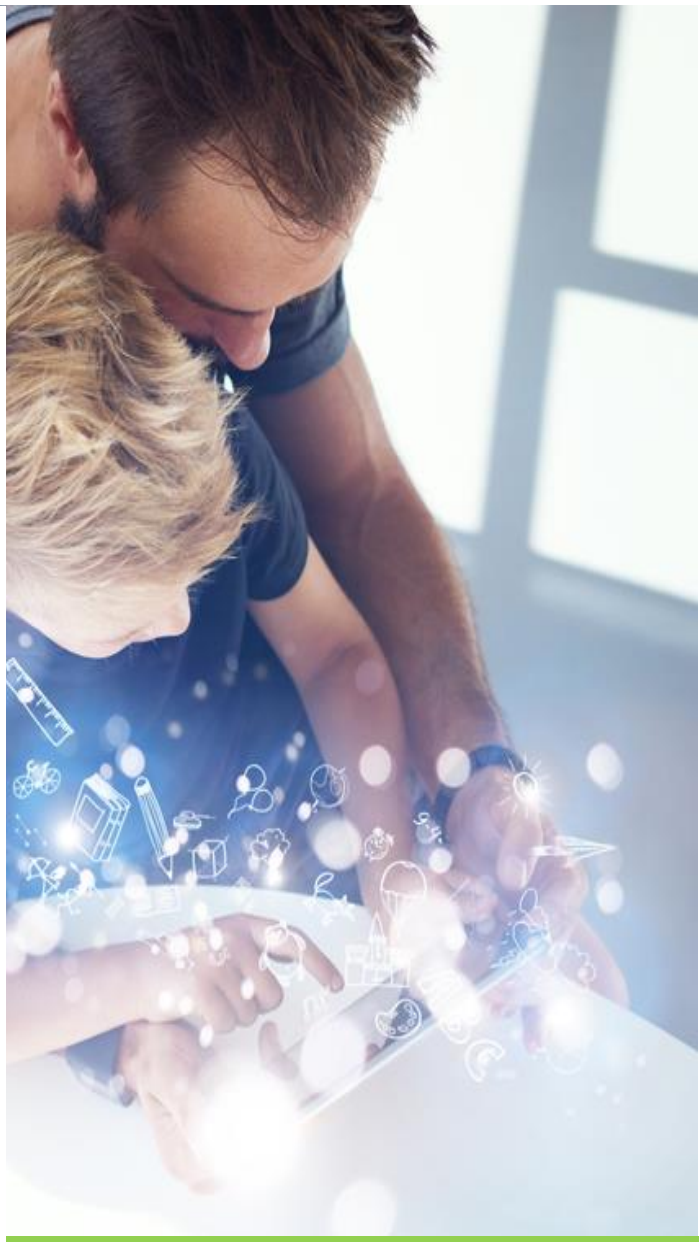
O2 - A1 Identification of training needs and challenges for teachers



AR4STE(Λ)M

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Executive Summary

Within the scope of the second Intellectual Output of the AR4STEAM project, namely 'Online Teacher Training Programme', all project partners – except HESO, which has the significant role of the technical partner of the project – conducted interviews involving directly school teachers, as the main project target group. The objective of the interviews was to identify the training needs and challenges that they face concerning the use of Augmented Reality technologies, gamified and game-based learning strategies in teaching STE(A)M subjects. In particular, **50 interviews** were conducted in DE, TR, IT, NL and BE towards discovering new methods of generating awareness about the use of game-based approach and augmented reality for conducting didactic activities and encouraging students' participation in STE(A)M learning activities and improving their performances in courses related to STE(A)M, etc. The current documents display the results derived from the interviews in all partner countries.

Contents

Set of Questions 1

Personal Note & Brief Overview

The first set of questions referred to the personal experience of school teachers in teaching STE(A)M subjects, the challenges they deal with and the resources they use.

The questions together with the results are displayed below:

1.1 What subjects are you teaching?

Results per country

The most popular STE(A)M subjects taught by school teachers comprise:

Germany:
- Chemistry (1 answer)
- Maths (2 answers)
- Computer Science (1 answer)
- Physics (6 answers)
- Biology (2 answers)
- IT / ICT (1 answer)
- Art (1 answer)

Italy:
- Science (2 answers)
- Chemistry (1 answer)
- Maths (4 answers)
- Physics (5 answers)
- Biology (1 answer)
- IT / ICT (1 answer)
- Engineering (1 answer)

Turkey:
- Electronics (6 answers)
- Computer Science (1 answer)
- Maths (1 answer)

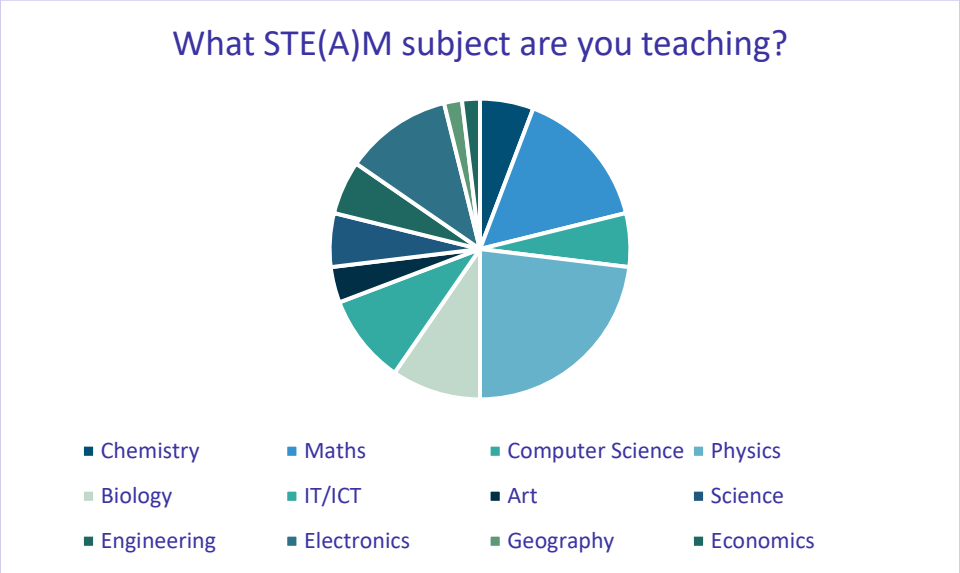
Netherlands:
- Science (1 answer)
- Biology (1 answer)
- IT / ICT (2 answers)
- Engineering (2 answers)
- Art (1 answer)

Belgium:

- Computer Science (1 answer)
- Science (1 answer)
- Economics (1answer)
- Technology (1 answer)
- Biology (1 answer)
- Chemistry (1 answer)
- Physics (1 answer)
- Maths (1 answer)
- Geography (1 answer)

Conclusions

It appears that the most popular STE(A)M subject taught by school teachers that were interviewed for the purposes of the project is Physics (12 answers), followed by Maths (8 answers), Electronics (6 answers), Biology and IT / ICT (5 answers each), Chemistry, Science and Engineering (3 answers each), Art (2 answers) and finally Geography and Economics (1 answer each), as displayed in the following chart.



Graph 1.1 What STE(A)M subject are you teaching?

1.2 For how long have you been teaching this subject?

Results per country

The years of experience in STE(A)M teaching are displayed below.

Germany:

- 1 – 3 years (4 answers)
- 4 – 6 years (1 answer)
- 7 – 8 years (1 answer)
- 9 – 11 years (4 answers)

Italy:

- 1- 3 years (2 answers)
- 4 – 6 years (1 answer)
- > 11 years (7 answers)

Turkey:

- 4 – 6 years (1 answer)
- 7 – 8 years (1 answer)
- 9 – 11 years (3 answers)
- >11 years (5 answers)

Netherlands:

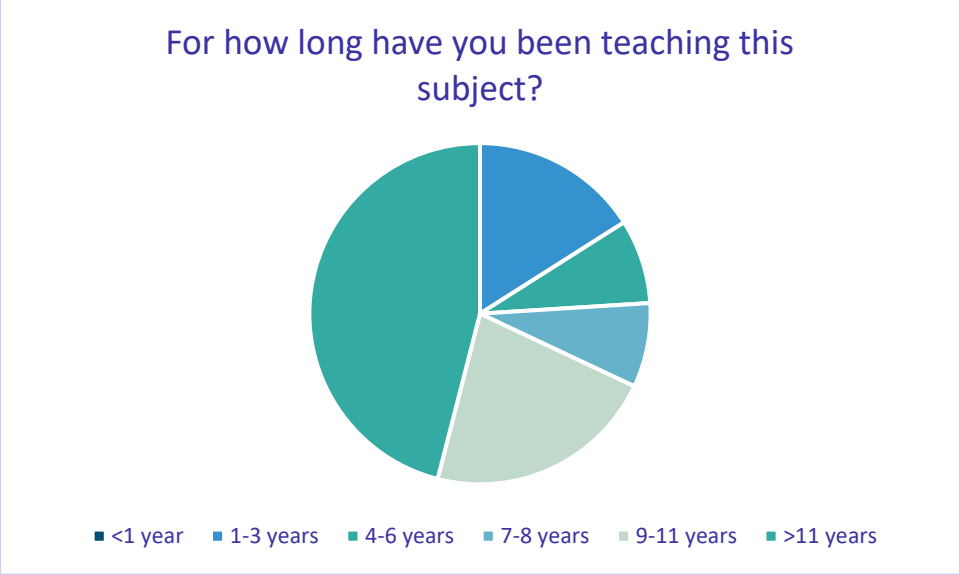
- 7 – 8 years (2 answers)
- 9 – 11 years (3 answers)
- >11 years (5 answers)

Belgium:

- 1 – 3 years (2 answers)
- 4 – 6 years (1 answer)
- 9 – 11 years (1 answer)
- >11 years (6 answers)

Conclusions

It appears the interviewees are rather experienced with most teachers have more than 11 years of experience in STE(A)M-subject teaching (23 answers), while many of them have 9 – 11 years of experience (11 answers), others 7 – 8 years of experience (4 answers), some of them 4 – 6 years of experience (4 answers), while 8 teachers have only 1 – 3 years of experience.



Graph 1.2 For how long have you been teaching this subject?

1.3 What have been the main challenges teaching the subject based on your experience?

Results per country

As STE(A)M teaching is quite a challenging task itself, interviewees were asked about the main difficulties they deal with based on their experience. The results are depicted below.

Germany:

- Too many kids with different levels within the class
- The changing interests and different skills in Physics students
- The limitation of time compared to the creative processes of children of different ages
- The changing composition of learning groups, addressing all basics in curricula while also current topics appropriate.
- To teach the understanding of abstract facts. This concerns above all changes of perspective in Display (3D - 2D) and non-visible processes such as electron movements and fields.
- To teach the basic understanding of computation and code
- To keep young kids interested in understanding complex scenarios.
- To understand the different levels of understanding at which one can must communicate with different groups of pupils.
- To manage different interest and pre-knowledge in heterogeneous groups
- To manage the low level of understanding of complexities

Italy:

- Find the right strategies to involve the most unmotivated and uneasy students, in classroom contexts where the concentration of these elements reaches high percentages.
- Make simply, clear and first of all interesting the subjects.
- Engage the students given the poor backgrounds they are coming from and the great lack of knowledge. Also, the small amount of time dedicated to the subject (even 2 hours a week for 1 year) the large number of students (nearly 30 for each class)
- Understand the complexity of realty, apply scientific method, make hypothesis and find answers, acquire soft and hard skills.
- The main challenge is to create passion among students about the subject and make it clear that mathematics is a universal language to be able to interpret many phenomena of the real world that surrounds us.
- The main challenge is still making the students do not dislike math and physics. Then another important issue is to find the good compromise between real and simplified cases and abstraction. There is also the challenge of designing appealing experimental lessons, without being too trivial.
- To be able to intrigue the student and teach him to ask himself the right questions in front of every problem.
- Overcoming the idea that the development of algorithmic solutions is an activity that only particularly talented students can carry out. To make not only students but also the education system accept that the development of algorithmic skills is not marginal but is central to the development of scientific thinking.

Turkey:

- There are not many 3D education materials and 3D animations.
- Not being able to reflect on imagination what I say.
- Computer and software knowledge, experience
- Some subjects are not interesting and theoretical lessons are boring in VET.
- The biggest challenge I have when teaching the subject is to show or apply real life experiences in the classroom.
- It takes a lot of practice to learn Unity and Vuforia programs well.
- Learned helplessness in Math. Lack of past learning outcomes. Readiness of the students. Helping students to improve their cognitive skills.
- Students' readiness, their interests on the subject

Netherlands:

- Imagination of how user experience looks like
- Motivation of students
- Preparation of practical situation of employer
- Explain difficult and abstract physics.
- Be aware that the world is always in development.
- Finding good resources to teach
- Insights how to build from 2D to 3D objects in real situation.

Belgium:

- The real transition from scholarly knowledge to understood / learned knowledge.
- Increase know-how and develop skills related to the subject.
- Make students aware of the importance of these lessons in everyday life.
- Students' interest in technical subjects and difficulties in understanding scientific phenomena; Difficulties in explaining scientific phenomena.
- Make the students be interested and open-minded.
- Different approach across the curriculum, integrating many experienced models (traditional form of teaching and new ways ICT tools, field works, online experiments, and lab experiments
- Lack of cultural and linguistic immersion of students
- Explaining how models and concepts relate to each other without knowing how to create these moving 3D models which would make my work in explaining so much easier
- Large amount of information and few courses to teach the subject, overloaded syllabuses, too few possibilities to visualize certain aspects of biology.
- During my first teaching experience it was hard to find the right methods for my type of teaching. I am open to innovative ways, that is why I prefer using technology during my lessons.

Conclusions

It appears that there are quite some hurdles in effectively teaching STE(A)M subjects, with the most crucial ones being, on the one hand, **students' lack of motivation** and interest in such subjects and, on the other hand, the difficulty that teachers face in explaining and **clarifying complex topics**, especially in Physics and Maths. Other factors that affect teachers' work include:

- Diversity of students within the same class

- Teachers' lack of knowledge in innovative teaching methods
- Limited resources for effective teaching
- Difficulty in transition of theoretical knowledge into real life

1.4 What are the main resources you need to teach the subject?

Results per country

The last question of the first set of questions concerned the resources currently needed by teachers for teaching their subject. The results are displayed below.

Germany:

- Technological resources:
  - standard experimental setting German educational system for secondary schools
  - books, blackboard
  - paper, brushes, different colors (water, crayons later oil), wood, fabrics etc., art historian books and design magazines
  - The possibility of making S-products and demo experiments accessible to the class, e.g., via document camera & beamer or tablet & beamer.
- Economic resources:
  - sufficient materials for student experiments
  - a small budget each year by the school/ministry for materials
- Human resources:
  - knowledge, motivation, creativity
  - certified teacher with year-long experience
  - expertise

Italy:

- Technological resources:
  - protected WI-FI connection for the students; a tablet for any student
  - big blackboards; laboratories
  - a modern visualization of mathematical concepts with the use of computer tools could help a lot to understand the subject.
  - resources for designing experiments: both instruments (or funds) and a dedicated technician supporting the teacher
  - drawing 3d software, mechanical laboratories
  - specific software for geometric visualization, videos, documentaries and beautiful paper texts
- Human resources:
  - support of another teacher or technician
  - well-trained teachers and technician in the laboratories

Netherlands:

- Technological resources:
  - digital Camera, VR, Mobile device, PC/Apple Mac
  - books, mobile devices, Chromebook
  - servers, cloud solution
  - PC, 3D glasses, mobile devices, 3d software tools
- Economic resources:
  - too small budget
- Human resources:
  - teachers with knowhow
  - creativity of teachers
  - teacher as expert
  - collaboration between teachers from different subjects

Belgium:

- Technological resources:
  - IT tools
  - to have laboratories allowing visualization and demonstration
  - computers, educational software, simulators, robots, gamifications
  - good access to written science sources, sources of ICT tools
  - software / videos illustrating certain objects, certain phenomena.
- Economic resources:
  - variety of support
  - books, newspaper articles, lawyers in class, ...
  - the possibility of upgrade
- Human resources:
  - network of teachers
  - study group with few students, modular study
  - collaboration with Faculties and Institutes
  - more contact with schools and students abroad
  - more time for research and get educated on how to make moving models myself. E.g., making a moving model of the circle of carbon in an app/program

Conclusions

With regards to technological resources, most teachers claim that the use of **computers/tablets/mobiles/other devices** can certainly facilitate their teaching, while in most STE(A)M subjects **laboratories** are also regarded as a must-have solution. Of course, different **software** and **hardware** are considered a significant asset for STE(A)M teaching, while **books** and **blackboards** can potentially enhance the learning experience.

As far as the economic resources are concerned, all teachers admit that there is very limited budget allocated to support teachers, while the materials provided for experimentation are rather insufficient.

Finally, with reference to the human resources, almost all interviewees claim that there is an urgent need of **involving domain-expert teachers with profound experience**, increase **teachers' creativity**, and promote the sense of **collaboration** among different departments.

Set of Questions 2

Previous knowledge and experience with gamification strategies and game-based learning methodologies

The second set of questions concerned the level of knowledge and experience of school teachers in the use of gamification and game-based learning techniques in teaching STE(A)M subject, along with the challenges they face.

Results per country

The purpose of the first question of this set was to identify any prior knowledge of STE(A)M teachers related to the concepts of gamification and game-based learning.
The results are displayed below.

2.1 Are you aware of any gamification strategy or game-based practice?

Germany:
8 out of 10 teachers replied that they are already aware of the terms, mentioning 'quizzes' as a gamification strategy and race, competitions, escape games, AR and VR as game-based learning practices.

Italy:
Same situation applies in Italy, with **8 out of 10** teachers being aware of the two terms, explicitly mentioning puzzles as a game-based learning method.

Turkey:
Similarly, **8 out 10** interviewees appear to be familiar with the terms of gamified and game-based learning.

Netherlands:
On the other hand, only **2 out of 10** teachers are aware of the terms in the Netherlands, naming quizzes, cards desks, digital field trips as examples of gamification, and role-playing games as a method of game-based learning.

Belgium:
The situation in Belgium reveals that teachers are rather unfamiliar with the terms, as **6 out of 10** are not aware neither of gamification nor of game-based learning.

Conclusions

As displayed in the graph below, luckily most teachers (60% of respondents) are already aware of the implementation of gamified and game-based learning techniques in STE(A)M teaching as methods that can motivate and engage students into the learning process.

Graph 2.1 For how long have you been teaching this subject?

2.2 Do you have any previous teaching applying gamification strategies?

This question basically refers to the actual integration of gamification strategies and game-based learning techniques into STE(A)M teaching.
The results are displayed below.

Germany:
Following up the first question, **6 out of 10** interviewees replied that they have already integrated gamification strategies into their teaching methods. An example of such an experience brings in the forefront the use of paper planes measuring forces as part of enhancing the creative learning process.

Italy:
As for the Italian teachers, **5 out of 10** of them answered that they have experience with gamification in STE(A)M teaching, mentioning kahoot (www.kahoot.it), time-oriented games and video-lessons as examples.

Turkey:
On the opposite, it seems that **none** of the STE(A)M teachers in Turkey are familiar with any of the two concepts.

Netherlands:
Similar situation applies in the Netherlands with only **2 out 10 teachers** having implemented such methods in STE(A)M teaching, naming playing cards as an example of gamified learning.

Belgium:
Finally, only **4 out of 10** teachers seem to have experience with the actual implementation of gamified learning in STE(A)M teaching, referring to role-playing games, scenarios, Lego® game, online quizzes as key examples of gamification.

Conclusions

While most teachers are proven to be familiar with the terms of gamification and game-based learning, it seems that only few of them (17 out of 50) have actually implemented such strategies in STE(A)M-related teaching, as shown in the following graph.

Graph 2.2 Do you have any previous teaching applying gamification strategies?

2.3 Are you aware of any educational game for your subject?

When it comes to the implementation of game-based learning, teachers were asked whether they have any experience with games developed for educational purposes.
The results are displayed below.

Germany:
5 out of 5 teachers claimed that they are aware of educational games used in STE(A)M teaching, with Die Honigbiene (WDR) being a profound example.

Italy:
Same situation applies also in Italy, with **5 out of 5** teachers having used games for educational purposes. Some examples include: quizzes with team play, kahoot, game about solar system.

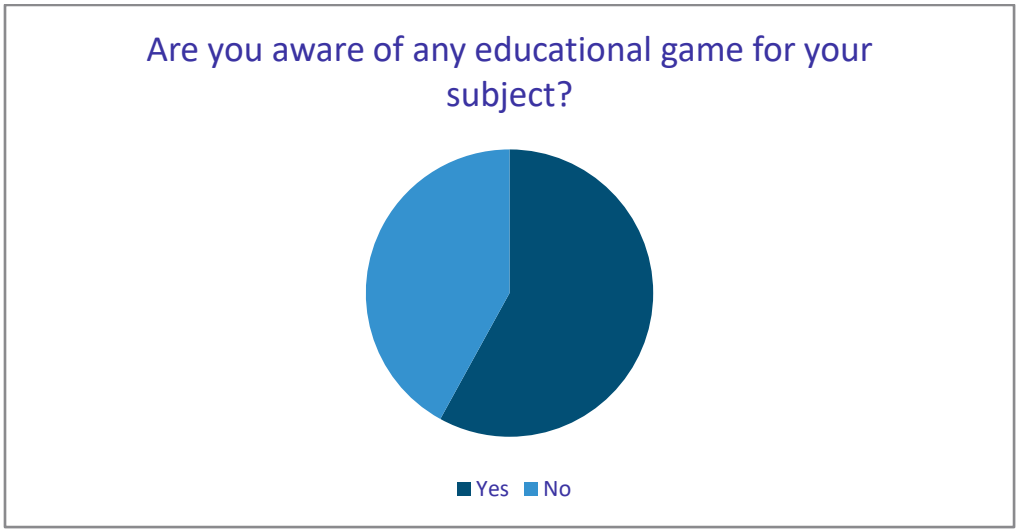
Turkey:
On the other hand, only **4 out of 10** teachers replied that they have previous knowledge in educational games.

Netherlands:
Quite surprisingly, **10 out of 10** teachers claimed that they have been using educational games in teaching STE(A)M-related subjects, mentioning code academy and scratch as examples.

Belgium:
Finally, **5 out of 5** teachers in Belgium confirmed their awareness on educational games, with The Merge cube being the only hands-on example.

Conclusions

Based on the findings from all partner countries, it appears that STE(A)M teachers are familiar with the use of educational games as a method to teach their subject. In fact, **29 out of 50** confirmed their knowledge in the field.



Graph 2.3 Are you aware of any educational game for your subject?

2.4 Do you think gamification and/or game-based methodology could bring an added value to your lessons? If yes, why?

Under the scope of identifying the main benefits of gamification and game-based learning in STE(A)M teaching, teachers were asked about their opinion with regards to the added value of such methods in teaching their subjects.
The results are displayed below.

Germany:
Although only **4 out 10** teachers admit that gamification and game-based learning approach actually have an added value in STE(A)M teaching, it seems that their explanation more or less covers the main benefits of such methods.

- Justification:
    - short spark of interest in a topic
    - to learn facts and figures from books it would be a nice add-on
    - extra fun
    - playful approaches are motivating if they are not used too often and their setting is credible.

Italy:

Fortunately, though, the situation in Italy seems to be more promising, with **8 out of 10** teachers believing in the added value of this approach.

- Justification:
    - Because they reduce learning fatigue, instilling greater confidence especially for the most unmotivated students.
    - Because Maths and Physics lessons are often difficult to understand and this makes difficult to maintain order in the classroom
    - Sometimes it could be useful to foster for student engagement, specifically if they are in a blended framework.
    - Because it would increase participation and attention of students
    - I think they could be a good strategy to make the subject less boring and more interesting.
    - Lessons will be less boring and more interactive. In such way students could learn by doing instead of just listening to the teacher.
    - It will certainly serve in the study of geometry involving a greater number of students.
    - To some extent and at certain moments they can surely be useful to involve those students who show difficulties, mainly motivational, due to different factors.

Turkey:

Similarly, **10 out of 10** teachers in Turkey addressed the added value of gamification and game-based learning approach in STE(A)M teaching.

- Justification:
    - Gamification and game-based learning are similar in the fact that both strategies promote engagement and sustained motivation in learning. However, gamification and game-based learning can also be usefully in the lessons.

Netherlands:

As in Turkey, **10 out of 10** teachers confirmed their opinion on the added value of gamified and game-based learning especially in teaching STE(A)M-related subjects.

- Justification:
    - motivation for students
    - different way of learning

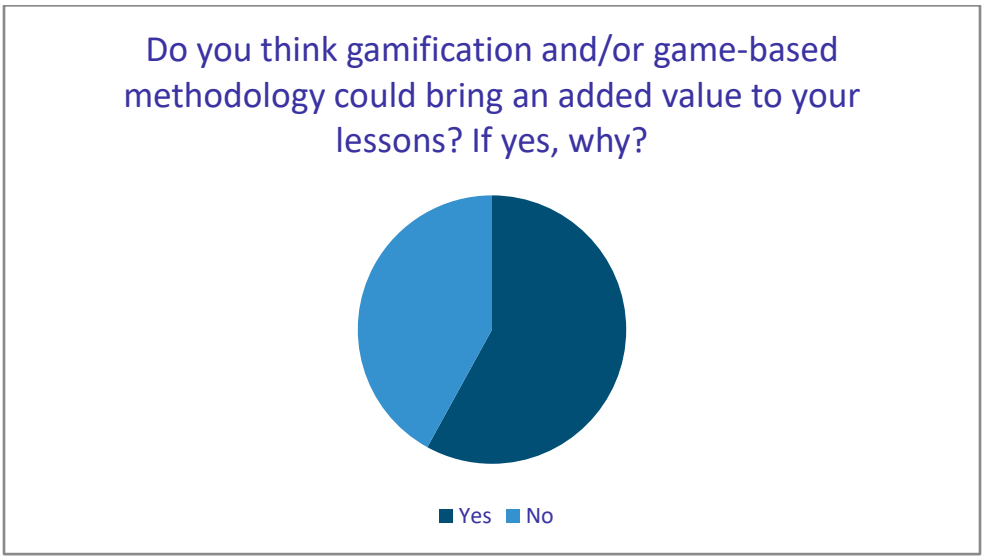
Belgium:

As for the interviews conducted in Belgium, **6 out of 10** teachers replied positively regarding the added value of such an approach.

- Justification:
  - Of course! To mark students' episodic memory, this promotes attention (important for learning) and facilitates data retrieval.
  - Yes, because students like games. Yes, because learning through playing is very important and can be effective.
  - For some modification to achieve goals as introducing new topics or assessment criteria, yes, but not in each phase in the learning process.
  - Everything that exceeds the formal learning practice is, according to my conviction, creating a longer lasting knowledge that the students remember maybe even their entire life.
  - This makes learning more attractive and also puts young people in a techno-cultural context.

Conclusions

Fortuitously, most teachers seem (38 out of 50) seem to recognize the added value that gamification elements and educational games offer especially in teaching STE(A)M-related topics, taking into account their complexity.



Graph 2.4 Do you think gamification and/or game-based methodology could bring an added value to your lessons? If yes, why?

2.5 Is there any resource (technological, economic, human, etc.) you would for the purpose?

Teachers were also asked what kind of resources they would use to apply gamified and game-based learning in teaching STE(A).
The results are displayed below.

Germany:

- Technological resources:
  - technical and experimental devices
  - the game components apart from the material we have
- Economic resources:
  - budget to purchase devices
  - we could do excursions in order to understand practical physics better, buy technical instruments such as an optical physics experiment set for each student.
- Human resources:
  - a training and exchange with others are always a good idea
  - more time

Italy:

- Technological resources:
  - protected WI-FI connection for the students; a tablet for any student
  - it could be enough a sheet of paper as well as LMS.
- Human resources:
  - I think I would need rather a detailed training with practical examples of educational games.
  - I think it will be necessary for teachers' team for designing such strategies and, furthermore, to offer a better "product" to the students. Indeed, I think that subject school department (e.g., the Department of Mathematics) could play an important role in designing new educational strategies.

Netherlands:

- Technological resources:
  - Hololens
  - software and hardware to build gamification programs.
- Human resources:
  - time to do experiments.
  - learning the theory behind gamification

Belgium:

- Technological resources:
  - Dedicated applications and a platform that would bring them together.
  - a computer in every class. It would be way easier if I would just need to come into class and open my online files. Now I have to bring my computer always in class. Intelligent beamers that could connect automatically with my cell phone would also be very nice.
- Economic resources:
  - budget for technical equipment
- Human resources:
  - training, mentoring
  - better information
  - examples of good practice
  - some coaching on what type of programs/games gamification strategies are out there.
  - more time

Conclusions

Regarding the technological resources, it appears that most teachers require dedicated applications and platforms for the implementation of gamified learning and game-based training techniques, along with devices (computers, mobiles, etc.) that can, of course, facilitate the use of such techniques. Rationally, the technological resources also need an allocated budget, while as far as the human resources are concerned, teachers replied that appropriate training and mentoring in conjunction with spending more time in the implementation of those methods constitute the main needs in the field.

Set of Questions 3

Previous knowledge and experience with AR

The third set of questions was related to the level of knowledge and experience of schoolteachers in the use of Augmented Reality technologies for STE(A)M-teaching purposes. The questions also addressed the challenges and resources relevant to the implementation of AR in teaching.

The questions together with the results are displayed below:

3.1 From 1 to 5, how familiar are you with AR?

The purpose of the first question of this set was to measure the level of experience of the teachers regarding AR content and to form their background.
The results are displayed below.

Germany:
The **3 out of 10** participants in the survey mentioned that they are “Quite Familiar” with AR while **4 out of 10** mentioned they are “Least Familiar”. The rest of the interviewees were Neither or Not so Familiar.

Italy:
The **5 out of 10** participants were “Least Familiar” while the other 5 were “Neither” nor “Not so Familiar” with AR technology

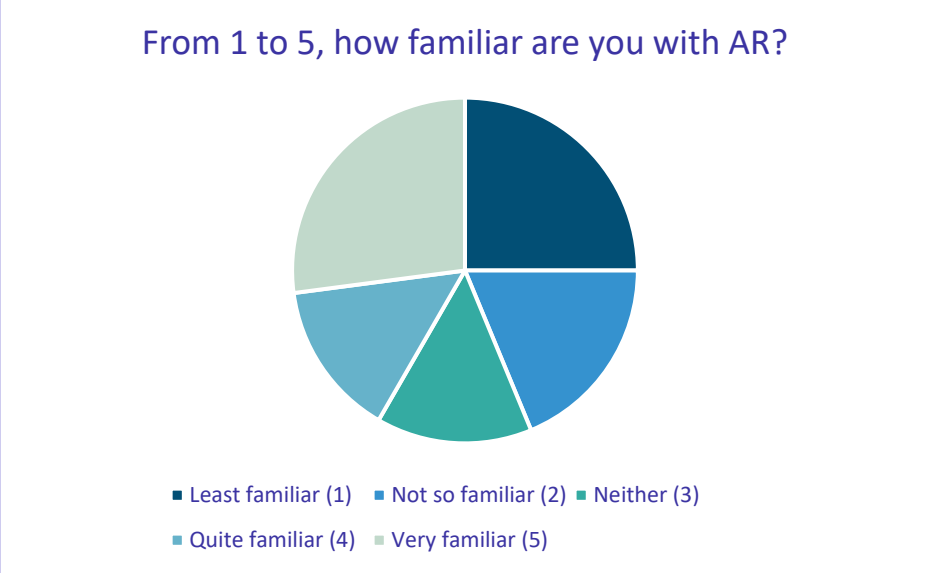
Turkey:
The **8 out of 10** interviewees were “Very Familiar” with the AR technology and only **2 out of 10** were Not so Familiar.

Netherlands:
The **5 out of 10** interviewees were “Very Familiar” with and **4 out of 10** were “Quite Familiar” AR technology. Only **1 out of 10** participants was “Not so Familiar”.

Belgium:
The **4 out of 8** interviewees mentioned they are “Not so Familiar” and the other **4 out of 8** mentioned the are “Least Familiar” and “Neither”.

Conclusions

Regarding the experiences of teachers with AR content and technologies, it seems that the majority of the interviews find themselves less experienced. In total 28 out of 48 selected the options of Least Familiar, Not so Familiar and Neither while 20 out of 48 selected the options Quite Familiar and Very Familiar, setting the diversity in between the interviewees, not with tremendous gaps, but still representing the need for enhancement of such experiences among teachers.



Graph 3.1: From 1 to 5, how familiar are you with AR?

3.2 Do you have any previous teaching and/or personal experience with AR and how would you describe it?

This question basically refers to the actual integration of AR content in learning techniques but also in their private experience.
The results are displayed below.

Germany:
Only **1 out of 10** participants have experience with AR learning techniques mentioning that is trying to experiment with Google applications and GeoGebra.

Italy:
The **4 out of 10** interviewees experienced AR content. They mentioned examples of their experiences such as the use of QR codes for exams answers and to give instructions in the laboratory, the use of HP Reveal Application to create AR content beginning from videos and photos and the experimenting with AR applications from the phone to generate content and AR games.

Turkey:
The **8 out of 10** participants have an experience with AR, also mentioning from some, that this knowledge was acquired through the participation in training for the creation of AR applications.

Netherlands:
All the 10 interviewees have an experience with AR content such as interactive books, advertisements in their everyday life and after visiting specific museums that engage such technologies.

Belgium:
The **1 out of 8** interviewees has experience with AR applications mentioning the use of the Merge Cube and the responsible app for students.

Conclusions

Regarding the total results from all the countries, it seems that the group of interviews is equally separated to people who have experienced AR content and applications but also people who have no experience on this topic.

Graph 3.2: Do you have any previous teaching and/or personal experience with AR and how would you describe it?

3.3 Are you aware of any AR apps & how they operate?

This question requests from participants to mention examples of AR applications and their function so as to gather their knowledge referring to the existed AR applications.
The results are displayed below.

Germany:
Only **2 out of 10** participants are aware of existing AR applications but they did not refer to any example.

Italy:
The **5 out of 10** interviewees are aware of existing AR applications and teaching platforms. As known applications/ platforms the mentioned the Aurasma, Metaverse, the HP reveal App and also Google Classes but with no personal experience on this.

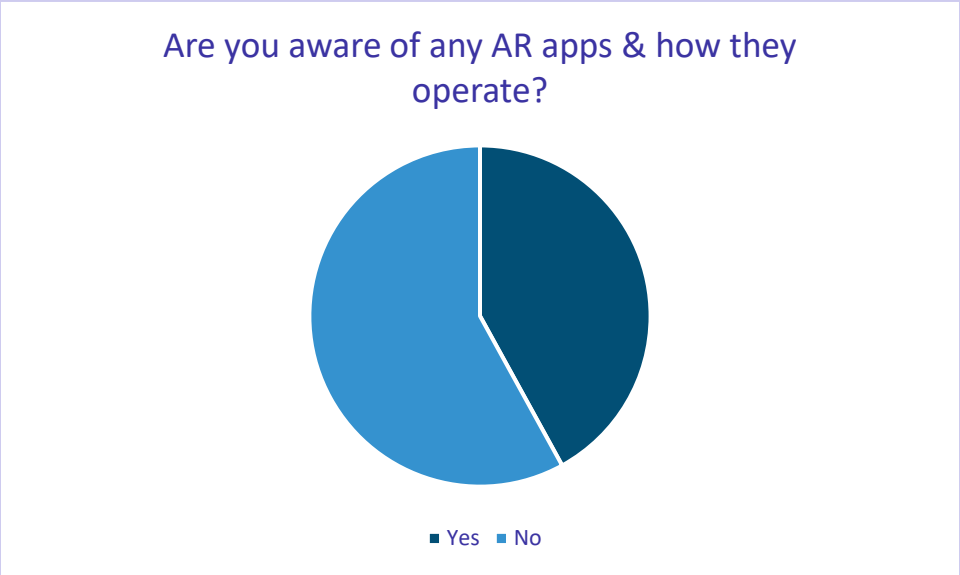
Turkey:
The **8 out of 10** participants are aware of existing AR applications and as mentioned they have created such applications through the Unity platform.

Netherlands:
The 4 out of 10 interviewees have met AR applications such as the Co-spaces educational platform, the extended reality by Microsoft and the Blippar App.

Belgium:
The **2 out of 10** interviewees know AR applications mentioning the Merge Cube and the responsible app for students.

Conclusions

With regards to the total results, it is represented in the graph that the majority of the participants they are not aware of existing AR apps and their functionality. The 29 out of 50 interviewees replied with No in the Survey while the rest 21 interviewees replied with Yes also providing some examples.



Graph 3.3: Are you aware of any AR apps & how they operate?

3.4 Are you aware of any AR technologies used for educational purposes?

Through this question, we target to gather more specific information on the knowledge of the participants of this survey on the AR technologies which have application in the educational filed. The results are displayed below.

Germany:
Only **4 out of 10** participants are aware of existing AR applications with use in the education sector with refer to GeoGebra.

Italy:
The **2 out of 10** interviewees are aware of existing AR applications in the educational field with refer to tools to add vectorial information to objects using an Oculus Quest.

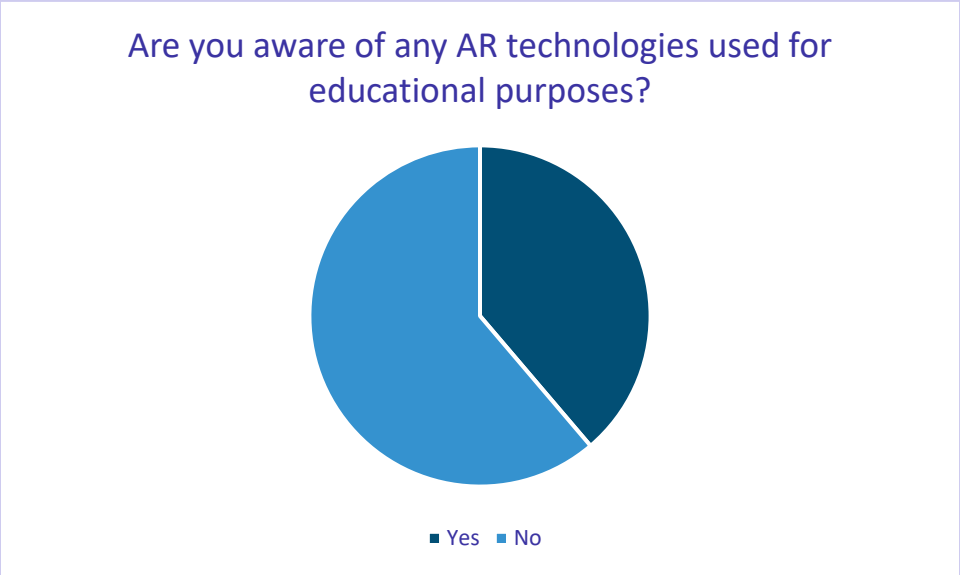
Turkey:
The **8 out of 10** participants are aware of existing AR applications for educational purposes such as HP reveal App and Co-spaces.

Netherlands:
The **3 out of 10** interviewees are aware of existing AR applications for use in the educational field mentioning Blippar.

Belgium:
The **2 out of 9** interviewees are aware of existing AR applications for use in the educational field mentioning the Merge Cube.

Conclusions

With regards to the total results, it is represented in the graph that the majority of the participants they are not aware of AR technologies used for educational purposes. The 30 out of 49 interviewees replied with No in the Survey while the rest 19 interviewees replied with Yes referring to such AR applications.



Graph 3.4: Are you aware of any AR technologies used for educational purposes?

3.5 Did you ever use AR tech in classroom? If yes, how would you describe your experience with it?

This question focuses on defining whether the AR content existed already is used by educators in classrooms and at which rate.
The results are displayed below.

Germany:
None out of 10 participants used AR technologies in their classrooms.

Italy:
The **1 out of 10** interviewees uses AR technologies during teaching mentioning the form of QR codes for exams and to share content during lessons connected with the use of a laboratory.

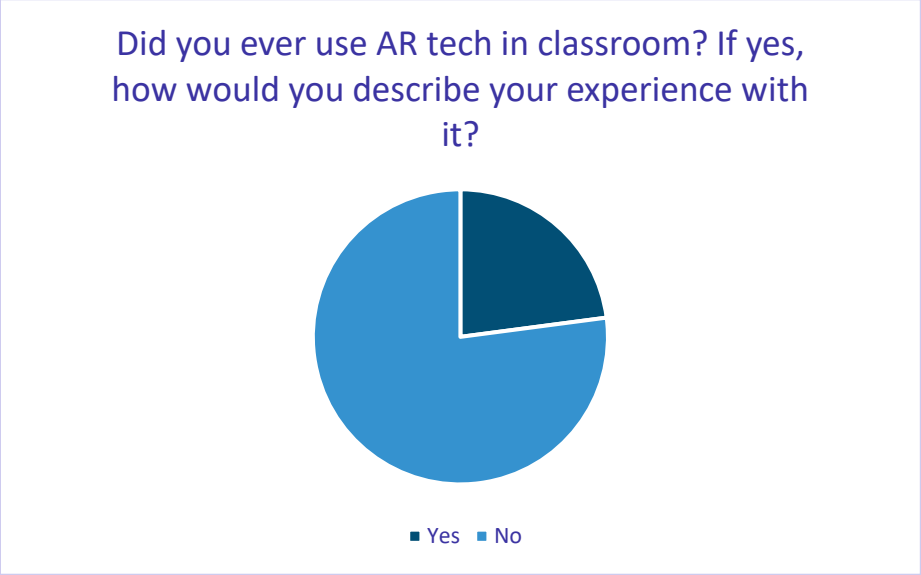
Turkey:
The **5 out of 10** interviewees use AR technologies in the classroom. It was mentioned the use of HP reveal App in Electric workshops.

Netherlands:
The **3 out of 10** interviewees use AR technologies in the classroom which is characterized as a positive and exciting new experience, for both the tutors and the learners.

Belgium:
The **2 out of 8** interviewees use AR technologies in the classroom mentioning that this experience raise the interest of students and they become more familiar with the IT field.

Conclusions

Regarding the outcome of this question, it is demonstrated from the results that even if there are known AR technologies useful for classrooms, they are not yet integrated in learning activities from the tutors. The 11 out of 48 interviewees replied positively in this question providing also positive feedback of this experience and the rest 37 participants replied negatively.



Graph 3.5: Did you ever use AR tech in classroom? If yes, how would you describe your experience with it?

3.6 Are you aware of the main benefits of AR in education?

Through this question we want to examine the awareness of the interviewees on the benefits that the AR technologies provide in the field of education.

The results are displayed below.

Germany:
The **4 out of 10** participants are aware of the benefits of AR technologies in education.

Italy:
The **3 out of 10** participants are aware of the benefits of AR technologies in education. Through their comments they mentioned as benefits that these technologies represent alternative teaching methods that attract the attention of the students.

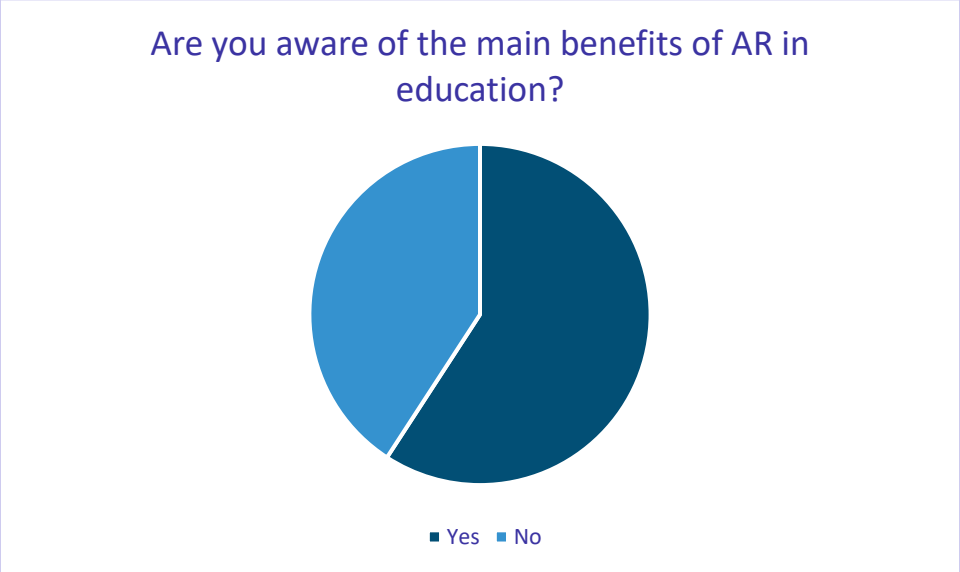
Turkey:
All the 10 interviewees replied that they are aware of the benefits of AR technologies in education, mentioning they increase the motivation and the interest of the students and decrease the absenteeism phenomenon.

Netherlands:
The **7 out of 10** interviewees replied that they are aware of the benefits of AR technologies mentioning that these technologies can present difficult topics with easier and interesting ways for the students.

Belgium:
The **5 out of 9** interviewees replied positively in this question mentioning that AR technologies represent an interesting educational method for the students.

Conclusions

Regarding the outcome of this question, it is demonstrated from the results that the majority of the interviewees recognize the benefits of the use of AR technologies in education. The 29 out of 49 interviewees replied positively in this question providing also positive feedback.



Graph 3.6: Are you aware of the main benefits of AR in education?

3.7 What current trends are baffling to you regarding in-classroom use of AR? Why?

Even though AR technologies can benefit the educational field there is the possibility that their use seams confusing for some people. The purpose of this question is for the participants to express their view on the perplexity that the use of AR technologies in the classroom may create.
The results are displayed below.

Germany:
The feedback gathered from the 10 interviewees defines that additional technological equipment such as beamers can be a problem if they do not work properly. The majority of the participants did not mention any confusion in the current trends.

Italy:
The feedback gathered out of 10 interviewees mentions:

- The attention to the technological details may reduce the clear content of lesson especially from the mathematical and physical point of view.
- The resources and the proper devices create a difficulty.
- The theoretical study of mathematics is difficult to be replaced by AR technologies.
- The lack of knowledge and experience of the tutor can create confusion.
- It is not easy to fit the AR activities in a school year teaching planning.
- There is the fear of the unknown technology creating the uncertainty for manipulating knowledge.

Turkey:
The feedback gathered out of 10 interviewees was related to the cost of the devices used in AR technologies but also on the harm related to health that can be caused by the use of devices such as AR glasses.

Netherlands:
All the participants did not mention any baffling situation in the current in-classroom AR trends.

Belgium:
The feedback gathered out of 10 interviewees mentions as baffling situations:

- The lack of user-friendly application in the AR technologies
- The lack of knowledge and experience from the tutor.

Conclusions

Taking into consideration the aforementioned feedback, we can conclude that basically the perplexity in the in-classroom AR trends it is linked mainly to the extra technical devices, which can be difficult in use or expensive, and to the lack of knowledge and experience of the tutors to perform and use in favor of the educational field the AR technologies.

3.8 What would be the most effective way to familiarise with AR technology & apps for you?

The purpose of this question is for the participants to express their opinion on the most appropriate methods for engaging with AR technology and apps, so as to conclude to the required methodology to be developed on this purpose.
The results are displayed below.

Germany:
The feedback given from the 10 interviewees mentioned as ways:

- The participation to educational fairs, workshops, and exchange programmes related to the AR technologies.
- The interaction in between people who have acquired this knowledge and experience, with those who are in need of this, through training programmes.
- The dedication of the free time for personal development in AR technologies
- An (on-demand) training course, depending on the interests of the user.

Italy:
The feedback gathered out of 10 interviewees was related to the beginning of practicing the AR technologies through educational programmes with additional final goal the creation of their own AR content and applications.

Turkey:
The feedback gathered out of 10 interviewees was related to the use of the appropriate equipment such as big screens and to the improvement technical specifications of the AR applications such as the visuals and the animations. Additionally, a richer content in AR applications will make them more effective in familiarizing.

Netherlands:
The feedback given from the 10 interviewees mentioned as ways:

- The organization of training sessions on the use of the AR technologies
- The organization of training session on how to change the didactical and pedagogical way of teaching with AR.
- The participation in workshops where less experienced teachers can acquire knowledge from those who already have a good knowledge and experience on the use of AR technologies in the field of education.

Belgium:
The feedback gathered out of 10 interviewees mentions as ways:

- The training on AR technologies
- The knowledge sharing from other experienced users and teachers.
- The opportunity to test the AR technologies before the train and the use in classroom.
- The existence of an online community for knowledge sharing

Conclusions

Taking into consideration the aforementioned feedback, the majority of the interviewees mentioned that in order to enhance their knowledge in the AR technologies and applications they need frequent training, contact with other experienced people and access to such equipment and programmes so as to test them.

3.9 Is there any resource (technological, economic, human, etc.) you would use for the purpose?

Teachers were also asked what kind of resources they would use to apply AR technologies and applications in their teaching methods.
The results are displayed below.

Germany:

- Technological resources:
  - Equipment to support the AR technologies and to be shared among students.
- Economic resources:
  - Budget to purchase devices
  - Budget for the cost of the maintenance
- Human resources:
  - A workgroup of students
  - An IT supporter specialized in these technologies to support the created programmes.
  - A teacher to train the rest of the teachers and to schedule the programme and activities.
  - Time

Italy:

- Technological resources:
  - protected WI-FI connection for the students; a tablet for any student
  - The purchase of equipment to support the AR technologies and to be shared among students.
- Human resources:
  - A technician to support the development of these technologies.
  - A trainer to share the knowledge among the tutors.

Netherlands:

- Technological resources:
  - Digital Devices
  - Tools to create AR objects.
- Human resources:
  - Learn how to collaborate with other teachers to support students.

Belgium:

- Technological resources:
  - Technical equipment
  - A software to teach certain elements of the field of each tutor.
  - VR glasses

- Economic resources:
  - Budget for technical equipment
- Human resources:
  - A collection of dedicated applications accessible to teachers, schools and students
  - Mentors and training sessions
  - Time and coaching

Conclusions

Regarding the technological resources, it appears that most teachers require devices for the use of AR technologies and applications and most specifically to share them to the students for this purpose. Rationally, the technological resources also need an allocated budget, while as far as the human resources are concerned, teachers replied that appropriate training and mentoring in conjunction with spending more time in the implementation of those methods constitute the main needs in the field.

Set of Questions 4

Previous knowledge and experience with gamification strategies and/or game-based learning methodology based on AR

The fourth set of questions aimed to address the level of knowledge and experience of school teachers in combining the use of game-based learning with the implementation of Augmented Reality technologies in teaching STE(A)M subjects.

The questions together with the results are displayed below:

4.1 Are you aware of any gamification strategy or game-based practice based on AR used for education?

Through this question, we aim to detect whether the participants have knowledge on existed practices that combine the gamified education in combination with AR technologies.
The results are displayed below.

Germany:
Only **1 out of 10** participants is aware of a strategy that combines gamification and AR in education with reference on the Virtuali-Tee application.

Italy:
The **1 out of 10** interviewees is aware of a strategy that combines gamification and AR in education with reference on the Geocaching.

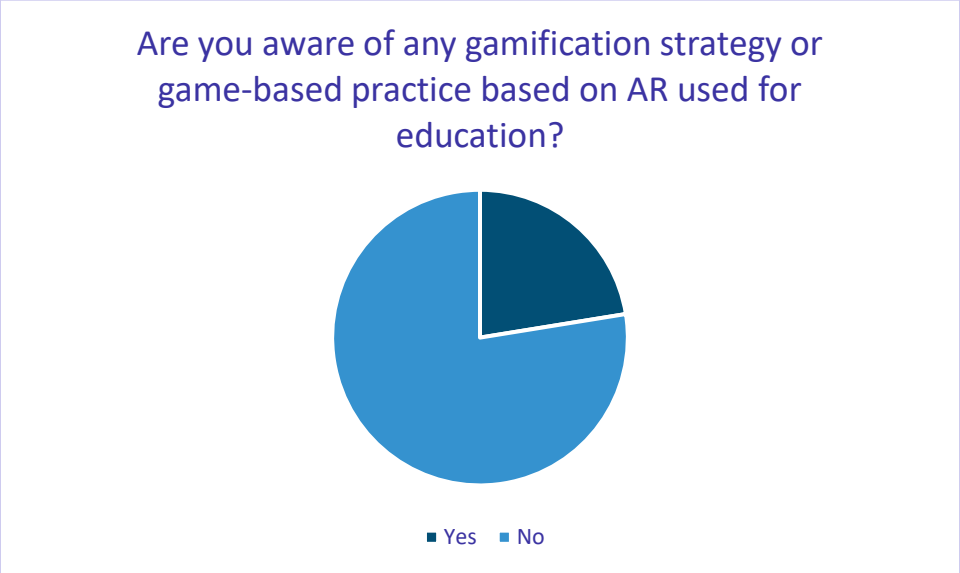
Turkey:
The **5 out of 10** participants are aware of existing strategies with gamified and AR content for educational use.

Netherlands:
The **2 out of 10** interviewees are aware of existing strategies with gamified and AR content for educational use.

Belgium:
The **2 out of 9** interviewees are aware of existing strategies with gamified and AR content for educational use.

Conclusions

With regards to the total results, it is represented in the graph that the majority of the participants they are not aware of strategies that combine the gamification and the use of AR technologies in the field of education. The 30 out of 49 interviewees replied with No in the Survey while the rest 19 interviewees replied with Yes.



Graph 4.1: Are you aware of any gamification strategy or game-based practice based on AR used for education?

4.2 Do you have any previous teaching applying gamification strategies based on AR?

This question serves to identify whether the interviewees follow a gamification strategy based on AR technologies and which strategy.
The results are displayed below.

Germany:
None out of the 10 participants is following a gamification strategy based on AR technologies.

Italy:
None out of the 10 participants is following a gamification strategy based on AR technologies.

Turkey:
The **1 out of 10** participants is following a gamification strategy based on AR technologies with reference to the SuperNova game.

Netherlands:
None out of the 10 participants is following a gamification strategy based on AR technologies.

Belgium:
The **1 out of 9** interviewees is following a gamification strategy based on AR technologies.

Conclusions

Resulting from the numbers of the negative answers in this question almost None of the participants is following a strategy combining gamification and AR technologies, which is a topic where actions could be taken to introduce tutors in those strategies.

Graph 4.2: Do you have any previous teaching applying gamification strategies based on AR?

4.3 Are you aware of any educational game based on AR for your subject?

This question serves to identify whether the interviewees acknowledge existing educational games with AR content referring to their specialization as teachers.
The results are displayed below.

Germany:
None out of the 10 participants knows an educational game based on AR regarding their subject.

Italy:
None out of the 10 participants knows an educational game based on AR regarding their subject.

Turkey:
None out of the 10 participants knows an educational game based on AR regarding their subject.

Netherlands:
None out of the 10 participants knows an educational game based on AR regarding their subject.

Belgium:
The **1 out of 9** interviewees knows an educational game based on AR regarding their subject.

Conclusions

Referring to the results it is demonstrated that in all the participants of all the countries participating in the survey, only 1 person out of 50 knows an educational game based on AR technology which is related to its subject. It is a logical result taking into consideration that to the previous question almost no one was acquainted with an educational strategy including gamification and AR content.

Graph 4.3: Are you aware of any educational game based on AR for your subject?

4.4 Do you think gamification and/or game-based methodology based on AR could bring an added value to your lessons? If yes, why?

Through this question we aim to gather the opinion of the interviewees on the value of a game-based methodology with AR content in the field of education and especially in the STE(A)M sector.
The results are displayed below.

Germany:
The **7 out of 10** participants mentioned that the use of gamification with AR content would be a valuable educational method since it will give a spark to students and motivation to learn.

Italy:
The **7 out of 10** participants mentioned that the use of gamification with AR content would be a valuable educational method since new teaching strategies with interactive character will raise the will of the students in learning.

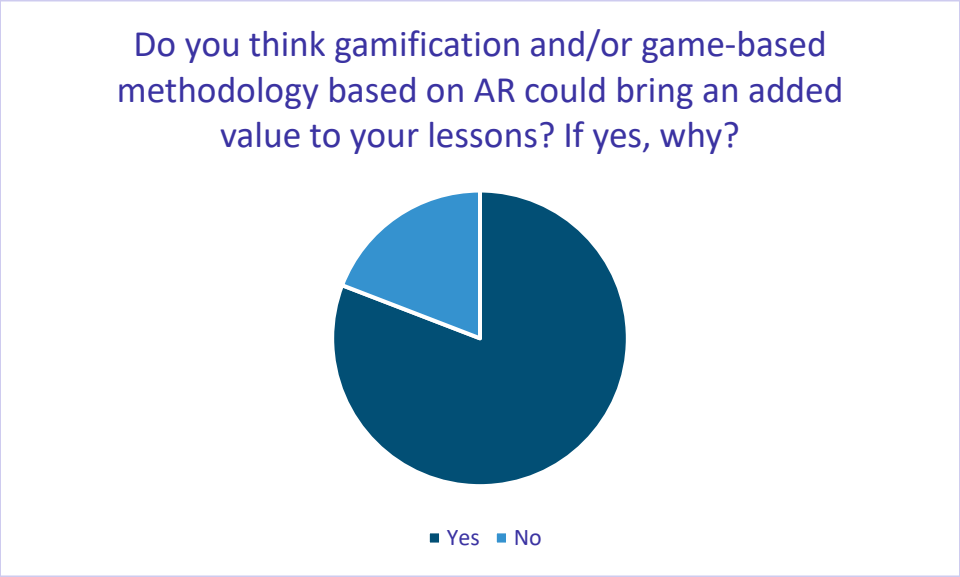
Turkey:
All the 10 interviewees believe that the use of gamification with AR content would be a valuable educational method. The benefits of augmented reality and gamification are not just centered around novelty –the technology can increase the potential for conversational learning. Children have been observed to learn better in groups and augmented reality educational tools help to provide a more 3D focal point for students to gather around. Students are given the opportunity to make achievements and go up levels until they eventually 'master' school, or graduate.

Netherlands:
The **7 out of 10** participants agree with the use of gamification with AR content in education since it motivates the students and personalized learning it is provided in different ways.

Belgium:
All the 7 interviewees replied positively to the aforementioned statement since they believe that this method will attribute interest for the students to explore new worlds and will make learning more attractive.

Conclusions

The majority of the participants believes that game-based methodology based on AR technologies has a valuable impact on the educational methods and can raise the attendance and active participation of students to the subject using following this type of methodology. The 38 out of the 47 replies were positive and only the 9 were negative on the statement of this question.



Graph 4.4: Do you think gamification and/or game-based methodology based on AR could bring an added value to your lessons? If yes, why?

4.5 Is there any resource (technological, economic, human, etc.) you would for the purpose?

The participants were also asked what kind of resources they would use to apply gamified educational strategies with AR technologies and applications in their teaching methods.
The results are displayed below.

Germany:

- Technological resources:
  - The appropriate technological devices and to be shared among students.
- Economic resources:
  - Budget to purchase devices
  - Budget for the cost of the maintenance
- Human resources:
  - An IT supporter specialized in these technologies to support the created programmes.
  - Time

Italy:

- Technological resources:
  - protected WI-FI connection for the students; a tablet for any student
- Human resources:
  - A technician to support the development of these technologies.

Netherlands:

- Technological resources:
  - Digital Devices
  - Tools to create AR objects.
- Human resources:
  - Learn how to collaborate with other teachers to support students.

Belgium:

- Technological resources:
  - Technical equipment
  - A software to teach certain elements of the field of each tutor.
  - VR glasses
- Human resources:
  - A collection of dedicated applications accessible to teachers, schools, and students
  - Mentors and training sessions
  - Time and coaching

Conclusions

Regarding the technological resources, it appears that most teachers require devices for the use of AR technologies and most specifically to share them to the students for this purpose.
Rationally, the technological resources also need an allocated budget, while as far as the human resources are concerned, teachers replied that appropriate training and mentoring in conjunction with spending more time in the implementation of those methods constitute the main needs in the field.

4.6 How much time do you think that could be devoted to introducing AR technologies/apps and keeping track of the students' progress weekly?

This question targets to measure the time required, weekly, from the participants to adopt and organize their work using AR technologies.
The results are displayed below.

Germany:
The majority of the interviewees mentioned that they would need 1-5 hours. The 4 out of 10 mentioned that they would need less than one hour.

Italy:
The **6 out of 10** participants mentioned that could be 1-5 hours and **4 out of 10** they did not know how much time this would take.

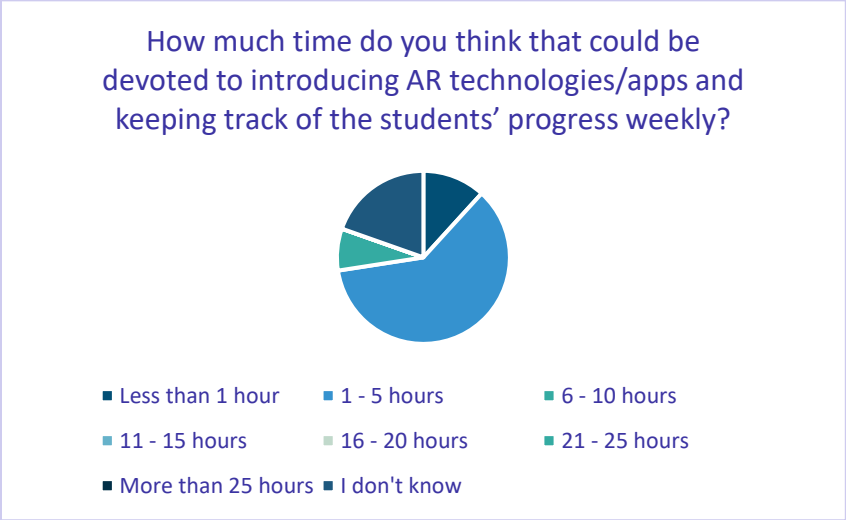
Turkey:
All the 10 interviewees mentioned that could be devoted 1-5 hours.

Netherlands:
The **7 out of 10** participants mentioned that could be devoted 1-5 hours and **3 out of 10** mentioned 6-10 hours.

Belgium:
The **2 out of 8** believe that could be devoted less than 1 hour, the **2 out of 8** believe 1-5 hours **1 out 8** believes 6-10 hours and **3 out of 8** they do not know how much time could be devoted.

Conclusions

The majority of the participants, 31 out of 48, believe that could be devoted 1-5 hours weekly to introduce AR technologies/apps and keep track of the students' progress weekly.



Graph 4.6: How much time do you think that could be devoted to introducing AR technologies/apps and keeping track of the students' progress weekly?

Set of Questions 5

Wrap up

The fifth set of questions referred to the expectations of the interviewees of the Online Training Programme and the areas that they wish to improve through the project.

The questions together with the results are displayed below:

5.1 What would you expect to gain out of this training?

Through this open question we target to gather the aims of the people who are going to participate in the training so as to create the appropriate training materials.
The results are displayed below.

Germany:
The participants of the survey mentioned that they expect:

- ✓ To exchange opinion and knowledge on the teaching methods through AR content and gamified techniques
- ✓ Learn practical examples of gamification in education.
- ✓ Learn on educational creative methodologies through technology to apply in classroom.
- ✓ To learn how to combine the gamification and AR content in the school principles and pedagogical concepts.
- ✓ Get a good overview of the different areas of application and learn about the first hurdles and the typical beginner's mistakes.

Italy:
The participants of the survey mentioned that they expect:

- ✓ To learn how to reduce learning fatigue, instilling greater confidence especially for the most unmotivated children.
- ✓ To understand and apply gamification and AR technology.
- ✓ A new methodology to visualize abstract concepts in a more exciting and engaging way.
- ✓ To start creating some Applications on their own. Some proposals on that:
    1. Integrated with an OCR algorithm an animated blackboard where the teacher could write an equation (by hand) and highlight the steps needed to solve it (have a look on graspable math (https://graspablemath.com/)
    2. Integrate to the APP at point 1 the possibility to have “pop up” graph representing the function (integrating something similar to Geogebra, https://www.geogebra.org/calculator)
    3. Have to possibility to make some animation on physics problem, for example set an electric field draw an electron and show its trajectory. At each point could be interesting to “freeze” the electron and access the parameters (electric field, electron position, speed etc.)
    4. Make some games involving some physical phenomenon: like parabolic motion using a cannon that should strike a fortress. Something similar to https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html or

something similar to Worms https://arcadespot.com/game/worms-armageddon-gameboy/ (designing the game could also be useful for students)

5. Have some experiment simulator as https://phet.colorado.edu/en/simulation/pendulum-lab , https://phet.colorado.edu/en/simulation/masses-and-springs
6. have something similar to a stellarium https://stellarium-web.org/
7. some animation (like drawing a circle and it will appear as the hearth), drawing a stickman and a man appears.
8. still using ocr have a handwriting tool that improves your calligraphy.

Turkey:

The Interviewees mentioned that they expect:

- ✓ To increase my experience in AR and gamification and to transfer this experience to students.
- ✓ To increase my knowledge and technical experience by getting to know AR technology more closely.
- ✓ To teach something easier, more permanent and fun using technology from this training.
- ✓ To use AR applications freely and have enough knowledge to inspire my students to be curious about them.
- ✓ Getting a new experience
- ✓ Create new projects based on AR.

Netherlands:

The Interviewees mentioned that they expect:

- ✓ How to use the technology of AR
- ✓ To learn examples of how to implement Gamification an AR in Classroom
- ✓ To explore possibilities of gamification and AR
- ✓ New didactical tools

Belgium:

The Interviewees mentioned that they expect:

- ✓ To discover and be able to put in place tools to improve students' understanding.
- ✓ Increase the quality of work with my students.
- ✓ To make teaching a less rigid procedure
- ✓ More effective learning
- ✓ To acquire new skills
- ✓ To generate Ideas and resources to apply the gamification strategies.
- ✓ To gain the basic knowledge of AR

Conclusions

Based on the replies of the participants their expectation of the gaining knowledge through this training relies on the personal development regarding the AR technologies, the gamification techniques, and the combination of the two in education. They are looking forward to dive into new educational strategies that will be beneficial not only for them as teachers but also for their students. They are willing to develop such skills to create materials that will enhance the interactivity of the lessons and will attract better the attention of their students providing them with skills and knowledge useful throughout their lives.

5.2 What would you expect to improve through integrating AR technology in-class?

Through this open question we target to gather the learning goals of the people who are going to participate in the training so as to create the appropriate training materials.
The results are displayed below.

Germany:
The interviewees of the survey mentioned that:

- ✓ They believe it would make some lessons more exciting and motivational.
- ✓ To present current technological advancements in the classroom, discuss their application with the students while learn to understand how they function together.

Italy:
The interviewees of the survey mentioned that they expect:

- ✓ To reduce learning fatigue, instilling greater confidence especially for the most unmotivated children
- ✓ Lessons will be more dynamical and practical and students more involved.
- ✓ To Learn new technologies
- ✓ Increase teaching quality.
- ✓ To Improve the learning timing of certain topics and the quality for some students

Turkey:
The interviewees of the survey mentioned that they expect:

- ✓ To make creative applications with students
- ✓ To make learning interesting, fun and long lasting
- ✓ The level of learning to increase as the student's interest and passion for the lesson increases.
- ✓ Increased interest to science and technology for the students
- ✓ To improve the slow learning pace of students and their comprehension difficulties.
- ✓ Children's using tech abilities in their life with useful apps.

Netherlands:
The interviewees of the survey mentioned that they expect:

- ✓ To connect to the need of the student in a different more personal way.
- ✓ Increase the motivation of the student.
- ✓ Make complex topics more concrete.

Belgium:
The interviewees of the survey mentioned that they expect:

- ✓ To improve students' understanding, and ultimately their learning. They advocate of educational diversification and programmed instruction.
- ✓ Deeper understanding of scientific and technical phenomena, increasing the quality of student work, streamlining student work.
- ✓ Students more energetic participation
- ✓ Motivation and attractiveness of courses
- ✓ Students will gain more knowledge.

Conclusions

Based on the replies of the participants through the use of integrating AR content they expect to improve their personal skills and provide more interesting and interactive learning while they will introduce their students to new technological experiences. They are looking forward to dive into new educational strategies that will be beneficial not only for them as teachers but also for their students.

They believe that the AR technologies will reduce the incapacity of the students, the courses will be more attractive, and the teaching methods will be much more easier.

5.3 What would you expect to improve through integrating gamification strategies and game-based methodologies in-class?

Through this open question we target to gather the opinion of the participations on the gamification strategies that they are interested in.
The results are displayed below.

Germany:
The interviewees of the survey mentioned that:

- ✓ They believe it would make some lessons more exciting and motivational.
- ✓ Depending on the quality of the content, the possibility to repeat content from physics classes outside of the school or after the lesson maybe.
- ✓ Explorative sessions are exciting for both teachers and students I think it would be a good opportunity to bring the kanon of art classes into the light of new realities of applications and technical development.

Italy:
The interviewees of the survey mentioned that they expect:

- ✓ To reduce learning fatigue, instilling greater confidence especially for the most unmotivated children
- ✓ To improve the interaction of teachers with the students and the interactions between the students
- ✓ Better Engagement
- ✓ To increase the quality of teaching for better profit for the students
- ✓ Active participation of students
- ✓ To make lessons more interesting and to stimulate the cognitive methods of the students.
- ✓ To improve the learning timing of certain topics and the quality for some students

Turkey:
The interviewees of the survey mentioned that they expect:

- ✓ Decrease in absenteeism, increase in class participation, realization of learning.
- ✓ Education quality
- ✓ To make the lesson more enjoyable and for the students to learn by having fun.
- ✓ Increase interest to science and to get rid of the idea being hopelessness to learn STEAM subjects for my students.
- ✓ To design more effective and enjoyable lessons.
- ✓ Faster, permanent, applicable learning. It is easier with this method.
- ✓ Permanent learning, concretization

Netherlands:
The interviewees of the survey mentioned that they expect:

- ✓ Create different way of learning.
- ✓ Increase the motivation in learning.
- ✓ Make education more flexible.

Belgium:
The interviewees of the survey mentioned that they expect:

- ✓ To Increase young people's interest in science and technology, for the jobs of the future
- ✓ To Increase young people's interest in vocational educational training.
- ✓ Students more energetic participation
- ✓ Higher quality of learning methodology

Conclusions

Based on the replies of the participants through the use of gamified content for educational purposes they expect to introduce to their students a funnier and easier way of learning. They want to make explore the technological possibilities through interactivity and alternative learning. They expect to make them interact with each other on the scope of common learning and to provide access to more qualitative education for all the students.

Thank you!

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