COMPENDIUM OF BEST PRACTICES IN A.R.

Funded Project	PT01-KA220-HED-000032018
Project logo	
Project Coordinator	
Partner logos	
PR2 Coordinator logo	

Requirements analysis document (RAD) | Compendium of good practices

The Requirements Analysis Document is a design model that aims to highlight the process by which the requirements of the compendium of good practices are translated into a representation of the requirements of the compendium of good practices of analysis components, examples, testimonials and data needed for the implementation phase. This RAD shows how the Compendium of Good Practices will be structured to fulfil the requirements for completing the nPEAR TOOLKIT. It is the main reference for the development of the practices and must therefore contain all the information needed by the nPEAR Project team to complete this stage of the project. This RAD Document is carried out in three phases. The first is a preliminary design in which the global state of the art in this scientific thematic area is addressed. In the second phase, the aim is to briefly discuss the testimonies of the partner countries of the N-Pear project and, therefore, the discussion of data structures is presented. In the third phase, which should contain the detailed research design phase, the detailed data structures are defined, and the results are collected and analysed.

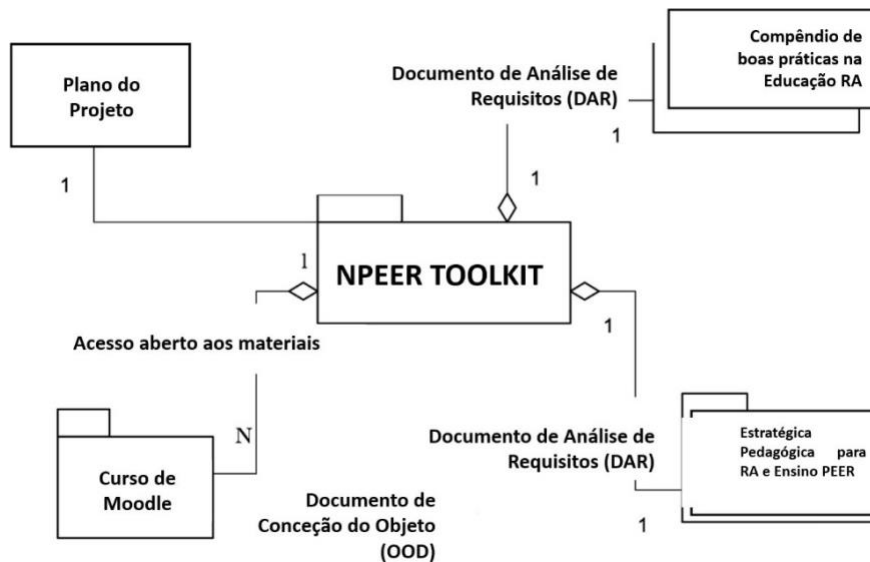This template is an annotated outline of the nPEAR TOOLKIT design document developed for the New Peer Augmented Reality Apps project. The document has been reduced in order to simplify this task, while retaining the main components and providing a general idea of a project definition report.

Team Name - Clictic S.L. (E10169458 - Spain) | Project Title - New Peer AUGMENTED REALITY

PR2 | Compendium of Good Practices
Project Number: PT01-KA220-HED-000032018

Date: (mm/dd/yyyy)

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INTRODUCTION

1.1 Objective

This design document describes the process of gathering background information (desk research on case studies) on the use of AR tools in teaching inside and outside the classroom. The research methodology will be based on grounded theory.

Both teachers and students will be subjected to peer learning activities and quizzes using the AR application toolkit developed in the Results 1 project.

The final output of this Compendium of Good Practices will serve as inspiration for educators, since AR is growing rapidly, but at the same time the world of immersive technologies is still uncharted territory for educators and their students, especially in EU universities, despite its immense potential.

1.2 Scope

With this compendium, the nPEAR project aims to map the educational use of AR in physical education, focusing on collaborative and peer learning approaches.
The consortium will map existing research findings and available applications, complementing these findings and validating them in case studies, following the research methodology of Informed Grounded Theory. The focus on peer learning and the collaborative learning approach falls within the framework of inclusive education as defined by the United Nations - taking into account personal needs and preferences. In 2016, the United Nations published General Comment No. 4 to explain the right to inclusive education, centring the new definition on providing all learners with an equitable and participatory learning experience and environment that best meets their needs and preferences.

The first objective is to gather background information (documentary research on case studies) on the use of AR tools in education inside and outside the classroom.
The second objective is to use the O1 toolkit and peer learning approaches in the partner organisations' countries to see how the tools and pedagogy work and to create a compendium of best practices.
The partners from Portugal, Spain, Italy, Greece and Latvia will collectively design peer learning activities using the AR application toolkit for courses in physical education subjects. The design will be implemented and evaluated by educators and students in each country and institution.
Twenty educators will be interviewed and the 60 students will answer a short questionnaire.

1.3 Summary

This document will compile the literature review on the use of Augmented Reality at secondary school level with the aim of promoting its use in conjunction with the peer tutoring methodology in the area of Physical Education.
To this end, the project consortium will carry out a series of surveys and semi-structured interviews with teachers and students to analyse the usability potential of AR applications to improve their teaching/learning experience.
The answers collected in these interviews will be analysed and their conclusions will contribute to the development of the other results included in the nPEAR project:
-    A set of AR application tools

- Compendium of good practices
- A pedagogical strategy for AR and peer learning
- A MOOC aimed at unlimited participation and open access via the Web, including elements of educational games
- Audiovisual material for the toolkit and MOOC
- Academic publications

2. SUMMARISING THE SYSTEM ANALYSIS

The N-Pear project combines the collaborative expertise of technology-enhanced learning researchers, computer scientists and educators to create a strategic partnership that simplifies the adoption of Augmented Reality (AR) technology in educational practice. The project will create innovative, open and specialised educational resources for physical education educators, which will help implement and integrate pedagogical approaches to active and collaborative learning supported by AR.

This will enrich teaching practice and support inclusive, peer-to-peer learning relevant to students' requirements and preferences. The N-Pear project is an extension of the three ERASMUS+ projects ViLi, i-Pear and AR-FOR-EU. ViLi (https://www.viliproject.eu/) aims to improve educators' visual literacy by making learning more visual through static, dynamic and interactive images. The AR-FOR-EU and I-Pear projects (https://codereality.net/) aim to train AR development skills for sports coaches. The N-Pear project further develops visual representations in learning and participatory learning approaches, specialising in physical education.

The main objectives are:

1. Mapping the educational use of AR in physical education, focusing on collaborative and peer learning approaches.

The consortium will map existing research findings and available applications, complementing these findings and validating them in case studies, following the research methodology of Grounded and Informed Theory. The focus on peer learning and the collaborative learning approach falls within the framework of inclusive education as defined by the United Nations - taking into account personal needs and preferences. In 2016, the United Nations published General Comment No. 4 to explain the right to inclusive education, centring the new definition on providing all learners with an equitable and participatory learning experience and environment that best meets their needs and preferences.

2. Facilitate the adoption of AR in physical education by creating freely accessible teaching and learning material for educators.

The new materials will include a toolkit of AR educational applications and platforms, complemented by guidelines for teachers, a compendium of good practices and a competency framework for AR educators, all available independently and made available as a MOOC with professionally designed audiovisual material).

3. Create and maintain a community of educational physical AR experts and other stakeholders to ensure the sustainability of the project and keep the most useful results up to date.

The design of the project is guided by European policies, strategies and tools. The project aims to improve the digital competence of educators, and subsequently their students, by developing a comprehensive set of open and accessible educational resources online worldwide (EU initiative

"Opening Up Education"). The project supports "Digital Learning and ICT in Education" 2018 and the "Digital Education Action Plan" 2018, promoting innovative and technology-enhanced learning practices, both with the content of the materials and by making all the materials designed and available online available as OER and as MOOCs. The project supports the European competence frameworks: "Digital Competence Framework" and the "Digital Competence Framework for Educators (DigCompEdu)", extending them to a framework of specific competences that educators need to integrate AR into their teaching.

2.1 Conception of Grounded Theory

Using the Grounded Theory methodology, we intend to carry out a bibliographical survey on the use of AR applications in higher education, which is still not widely used. Some studies have already proved its great potential in some areas, so we focused our case studies on the areas of Physical Education.

With the creation of a compendium of good practices, we will analyse their potential usability with tools such as interviews and questionnaires with teachers and students in the area of Physical Education in Secondary Schools.

The compendium of good practices will also complement the other results of the nPEAR project mentioned above. This compendium will be updated regularly throughout the lifetime of the project.

2.2 Description and literature review

ICT has taken on a very important role in all areas of our society. Firstly, their use has been associated with areas related to hobbies, communication or the development of new production methods, etc. However, this digital revolution in education conditions what we know and how we learn it, linking it to the need for a new educational approach and acquiring new skills, with the idea of incorporating these resources into the training process (Engen, 2019).

This new approach will not only affect students or educational models, but will also require prior training for teaching staff, who must adapt to new methodologies and digital skills, as well as update their resources and tools used in the classroom.

Within these emerging technologies, we can distinguish between:
- Augmented reality (AR): the integration of digital information into the user's real environment.
- Virtual reality (VR): creates a completely artificial environment.
- Extended reality (RX): also known as "mixed reality", it encompasses all environments, real and virtual, represented by computer graphics or mobile devices.

These technologies form an ecosystem of extension and a new relationship with reality which, as has already been pointed out in different editions of the Horizon report (Adams et al., 2018; Alexander et al., 2019; Brown et al., 2020), have a strong level of penetration in our centres and universities, some of them according to Gartner's hypercycles, which is a graphical representation of the maturity, adoption and commercial application of a specific technology.

Lately, the use of these technologies is becoming very important, as can be seen, in part, in the growing number of research studies and publications on the subject. Vergara et al. (2021) point out that the areas of health, engineering and architecture are where they have been used most frequently and, moreover, with satisfactory results.

Radianti et al. (2020) also mention in their publications that the areas of medicine, social sciences,

neuroscience and psychology are where these technologies have been most used. However, some experiences of use have also been found in areas such as languages (Garrido-Iñigo and Rodríguez-Moreno, 2015; Nicolaidou et al., 2021), physical education (Guo, 2016), art and history (Future of Education Technology Conference [FETC], 2021; Kukulska-Hulme et al., 2021), maths (Birt et al., 2017), technical drawing (Alvarado et al., 2019) or tourism (Alvarado et al., 2019). As a result, it can be seen that, in higher education, the subjects in which these technologies have been used are quite broad and diverse.

In this context, the N-Pear project aims to gather background information (desk research on case studies) on the use of AR tools in education inside and outside the classroom. The second objective is to use the O1 toolkit and peer learning approaches in the partner organisations' countries to see how the tools and pedagogy work and to create a compendium of best practices.

Although there are still not many studies on the use of this technology in higher education, it is already clear that its application is leaving its mark on education (Alkhattabi, 2017; Cabero- Almenara, Fernández Batanero and Barroso-Osuna, 2019). The studies carried out to date have highlighted some benefits, such as students' favourable attitudes or its great motivating power (Kamarainen et al., 2013). In addition, their ability to promote the creation of constructivist training contexts has been highly valued (Wojciechowski y Cellary, 2013), as well as realistic learning contexts (Alkhattabi, 2017).

On the other hand, they also favour the creation of active teaching environments (Akçayır and Akçayır, 2017; Cheng, 2017), arousing a high degree of satisfaction and positive attitudes in students (Cheng, 2017; Díaz Noguera et al., 2017; Marin Diaz, 2017). Finally, authors such as Cabero Almeransea and Barroso Osuna, 2018, have demonstrated its power to improve learning outcomes.

Since its use is not yet widespread, especially in some areas, it is still necessary to establish teaching-learning protocols that guarantee the success of this technology in education. It is important for teachers to be trained in this type of technology in order to create complementary materials that help students and improve their learning process (Martínez Pérez et al., 2021).

2.3 Project rationale

As there are not many research studies on the use of AR applications in physical education at secondary school level, the main aim of this compendium is to map the educational use of AR in physical education, focusing on collaborative and peer learning approaches. The consortium will map existing research findings and available applications, complementing these findings and validating them in case studies, following the Grounded Theory informed research methodology. The Grounded Theory (GT) approach is a widely cited and frequently used approach in a wide range of disciplines and subject areas, including the field of qualitative research in education (Thornberg, 2012). According to the same author, this methodology refers to a product of a research process, as well as the research process itself, in which both the process and the product were fully grounded in data from GT methods, while at the same time being informed by research literature and existing theoretical frameworks.

The focus on peer learning and the collaborative learning approach falls within the framework of inclusive education as defined by the United Nations - taking into account personal needs and preferences.

3. COLLECTING DESIGN DATA

3.1 Data description

To collect data, the partners used 2 types of questionnaires, depending on whether the user was a student or a teacher.

Both the teachers and students who took part in this study signed a data protection document that is kept in a private folder within the project documentation.

Appendix 3: Participant information sheet and consent form Participant information sheet

We would like to invite you to take part in a research study on inclusive peer learning with augmented reality tools in higher education (nPEAR). The nPEAR project is co-funded by the European Union under the ERASMUS+ Programme.

Please read the following information carefully before deciding whether or not to take part.

What is the study about?

The nPEAR project combines the collaborative expertise of technology-enhanced learning researchers, computer scientists and educators to create a strategic partnership that simplifies the adoption of Augmented Reality (AR) technology in educational practice, especially in physical education. The project will create innovative open educational resources for educators to help implement and integrate active and collaborative learning pedagogical approaches supported by AR. This will enrich teaching practice and support inclusive, peer-to-peer learning relevant to students' requirements and preferences. The nPEAR project is an extension of the three ERASMUS+ projects ViLi, iPEER and AR-FOR-EU. The nPEAR project further develops visual representations in learning and participatory learning approaches, especially in the field of physical education.

Project objectives:
1. Mapping the educational use of AR, focusing on peer learning approaches
2. Facilitate the adoption of AR in education by creating freely accessible teaching and learning material for educators.
3. Create and maintain a community of educational AR experts and other stakeholders to ensure the sustainability of the project and keep the most useful results up to date.

Why was I invited?
You have been invited because you have significant experience in the field of higher education. We are interested in understanding whether peer learning and AR tools (peer approach) have the potential to improve students' motivation, engagement and learning ability/autonomy.

What will they ask me to do if I take part?
Your participation will involve being interviewed and answering questions about the peer learning approach. The 30-minute interview will be recorded and will take place at a time convenient to you. It will be conducted using videoconferencing software, but you can switch the camera off if you prefer so that it is just an audio recording.

What are the possible benefits of taking part?
Your ideas on the peer-to-peer approach will help improve our understanding of peer learning and how it is being approached in higher education institutions. There are no immediate benefits for

you, but you will be able to access the free resources produced by the project.

Am I obliged to take part?
Whether or not you take part in the project is entirely up to you. Your participation is voluntary.

What if I change my mind?
If you change your mind, you can withdraw before or during the interview and up to 2 weeks afterwards. If you want to withdraw, let us know and we will extract all the data (including the audio recording) you contributed to the study and destroy it. However, it is difficult and often impossible to remove a specific participant's data once it has been anonymised and grouped with other people's data. It is therefore only possible to withdraw data up to 2 weeks after participation in the study.

What are the possible disadvantages and risks of taking part?
There are unlikely to be any major disadvantages or risks in taking part in the study. However, the interview will take up around 30 minutes of your time.

Will my data be identifiable?
We will keep all personal information concerning you confidential (for example, your name and other information that could identify you). We do not share it with third parties. We will delete all personal information from the written record of your contribution. If you wish to be identified, we will do so with your consent, for example if you share advice for other educators.

How will we use the information you have shared with us and what will happen to the results of the research study?
The data you share will be used for academic purposes only. It will contribute to: a compendium of good practices on peer pedagogy; the development of teaching materials for educators; and the creation of a MOOC. The combined results of the study can also be presented to academics and professionals in project reports, journal publications and at conferences and workshops.
In writing the conclusions of this study, we would like to reproduce some of the views and ideas you shared. In doing so, we may use your exact words, but we will not use your name or other information that could identify you, unless you give us permission to do so.

How will my data be stored?
Your data will be stored in encrypted files (and only the research team will be able to access them) on password-protected computers and university servers. We will keep hard copies of all data securely in locked cabinets. We will keep data that can identify you separately from non- personal information (for example, your opinions on a specific topic). We will keep data securely for a minimum of ten years.

What if I have a question or concern?
If you have any questions about the research or if you are not satisfied with anything that happens in relation to your participation in the study, please contact:

Thank you for considering your participation in this project.

CONSENT FORM

Project title: nPEAR | Erasmus+
Name of researchers: Email:

Tick each box

1. I confirm that I have read and understood the information sheet on the study in question. I have had the opportunity to analyse the information, ask questions and have received a satisfactory response.	
2. I understand that my participation is voluntary and that I am free to withdraw at any time during my participation in this study and within 2 weeks of my participation in the study, without giving any reason. If I withdraw within 2 weeks of participating in the study, my data will be deleted.	

3. I understand that the information I provide may be used in future reports, academic articles, publications or presentations by the researcher(s), but my personal information will not be included and I will not be identifiable.	
4. I understand that my name/the name of my organisation will not appear in any reports, articles or presentations without my consent.	
5. I understand that any interview will be video-recorded (or audio-recorded, if you prefer) and transcribed, and that the data will be protected on encrypted devices and kept secure.	
6. I understand that the data will be kept for a minimum of 10 years after the end of the study.	
7. I agree to take part in the above-mentioned study.	
1. Would you like to be identified as a case study collaborator (Yes) (I understand that I can participate in the study anonymously by answering No).	

_____ _____ _____
Name of participant Date Signature

I confirm that the participant was given the opportunity to ask questions about the study and that all the questions asked by the participant were answered correctly and to the best of my ability. I confirm that the individual was not coerced into giving consent and that consent was given freely and voluntarily.

Signature of researcher/person collecting consent _____Date_____
Day/month/year

A copy of this form will be given to the participant and the original will be kept in the project coordinator's files.

Teacher survey: this survey will be carried out in a semi-structured way. The interviews will be conducted orally, as this makes a big difference to the usability of the research.

Annex 1: Research questions for the semi-structured interview with the educators

A.
1) Course title
2) Duration (hours)
3) AR tools used
4) Learning objectives
5) Did the class achieve the learning objectives?
6) What tasks did the students learn from their colleagues (peer learning) in relation to the use of Augmented Reality tools?
7) Do you think that the combination of Augmented Reality and peer learning helped to achieve the learning objective(s) and in what way?

B.
1) Did the use of the combination of "peer learning" and "AR technology" stimulate the students' desire to learn? Were the students more active in class than usual? If so, why do you think so?
2) How could the nPEAR approach better motivate students' participation in the learning process?
3) How could the nPEAR approach give students more knowledge and skills?
4) Would you consider using the nPEAR approach again?
5) How can the nPEAR approach be improved?

C.
1) Did you have any technical difficulties or other difficulties/challenges?
2) Share with us any other information you'd like to add about the nPEAR experience.

D.   **Student survey:** consists of four single-choice questions on a Likert scale that can be supplemented by additional comments from students on "why".

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All responses will be stored in Excel files and will be kept anonymously in the same folder as the consent forms.

Annex 2: Student survey questions

1. Did you find the combination of Augmented Reality and peer-to-peer learning interesting?
   a) Very interesting b) Somewhat interesting c) Neutral d) Not very interesting e) Not interesting at all
   Please explain why

2. Do you find teaching your colleagues using AR more motivating than a normal lesson?

   a) Extremely motivating, b) Somewhat motivating c) Neutral d) Not very motivating e) Not motivating at all

   Please explain why

3. Do you think AR, combined with peer learning, can also be applied to other classes?

   a) Always, b) Sometimes c) Once in a while d) Rarely e) Never
   Please explain why

4. Has this approach to learning made you feel more responsible for your class and the learning process?
   a) A lot b) A little c) Neutral d) Not at all e) Not at all
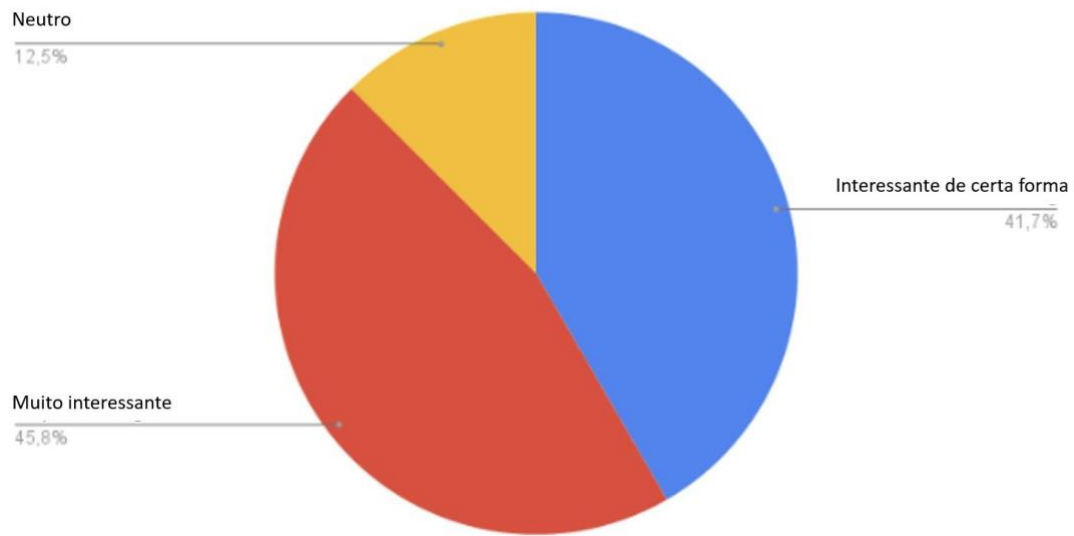
   Please explain why

Case Studies

This compendium will be constantly updated with more case studies throughout the life of the project in order to obtain as much information as possible. As we are following the methodology of Informed Grounded Theory, the literature will also be constantly reviewed for relevant updates that can bring more information to our conclusions.

Case studies from Greece

Group 1

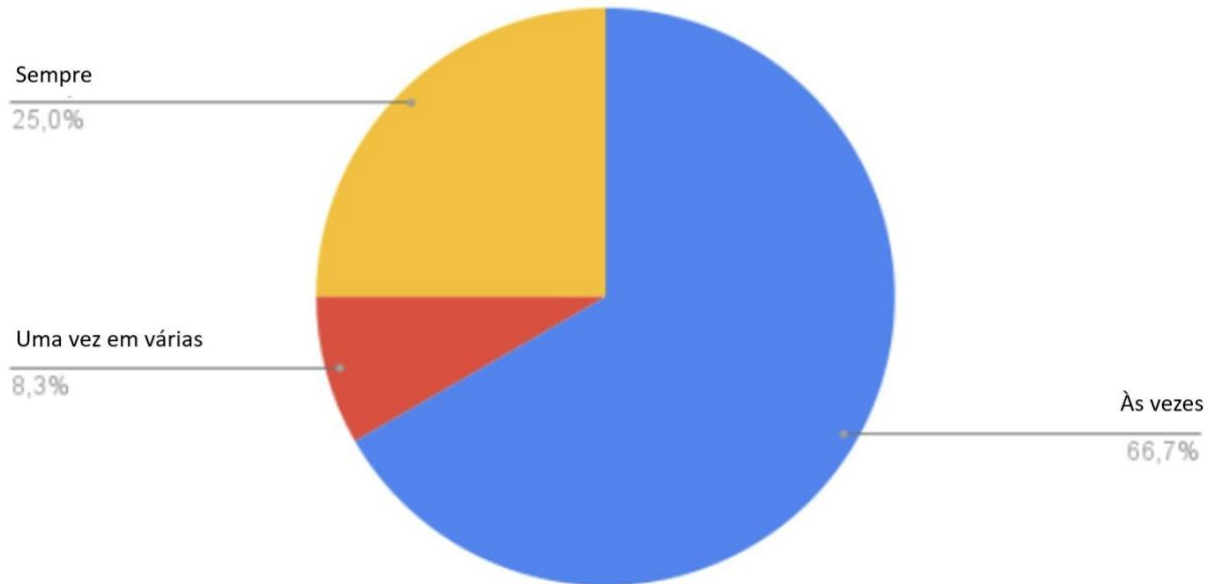## 1.Considerou a combinação de Realidade aumentada com o ensino a pares interessante?

Neutro
12,5%

Interessante de certa forma
41,7%

Muito interessante
45,8%

Group 2

Respostas

Neutro 14%

Muito interessante
52%

Interessante
de certa forma
34%

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3. Considera que RA, combinada com o ensino a pares poderá ser implementado em outras aulas?

Sempre
25,0%

Uma vez em várias
8,3%

Às vezes
66,7%

4. A forma de ensino utilizada fê-lo sentir mais responsável em relação às aulas e ao processo de ensino?
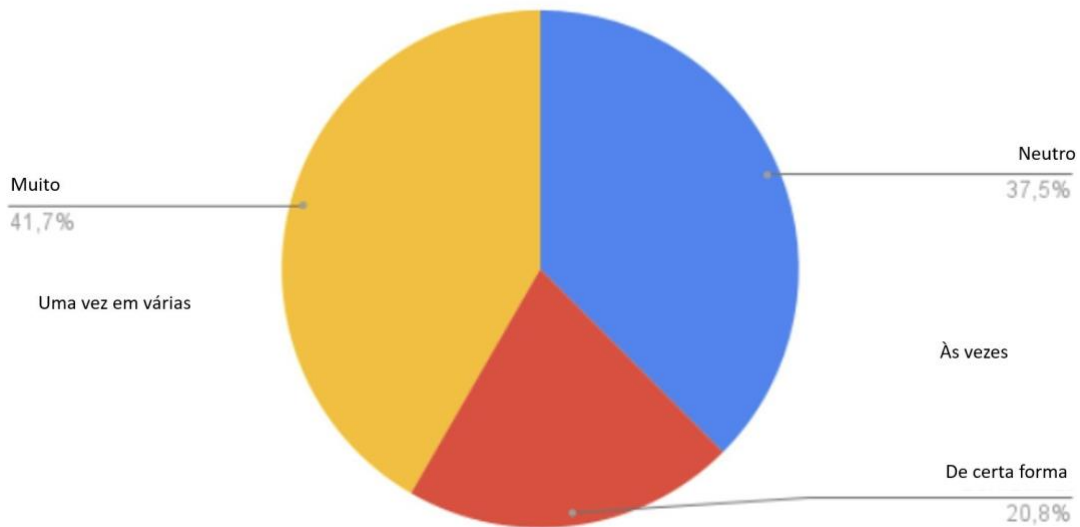
Group 1

4. RESULTS AND DEVELOPMENT OF THE ANALYSIS

4.1 Summary of research results
Once the case studies had been implemented, all the students took an online survey (anonymously) and all their answers were stored in an Excel file. With all the answers, it was possible to create diagrams and study their trends.

Results for group 1:

1. To the question Did you find the combination of Augmented Reality and peer learning interesting?

There were no negative responses, which means that both AR and peer learning are interesting to the students. The results showed that 45.8 per cent said it was very interesting and 41.7 per cent considered it somewhat interesting. The remaining 12.5 per cent considered it neutral.
Some of the students' comments were as follows:
   ✓ It's something special and exciting, something like a journey.
   I believe there are many perspectives and uses for this form of learning, as it makes the classroom more interactive and at the same time introduces the student to the world of technology.
   A fun, playful and educational way to get in touch in virtual reality with a dinosaur, a landscape or the sky.

2. To the question Do you find teaching your colleagues using AR tools more motivating than a normal lesson?

There were no negative responses; the students adopted the methodology in a very positive way. According to the student, the only neutral response was due to the initial phase of the test.
On the other hand, the rest of the students were almost equally divided: 50 per cent of them found the

experience extremely motivating, while 46 per cent found it somewhat motivating.

3. To the question Do you think AR, combined with peer learning, can also be applied to other classes?

   Only 25 per cent of students think it is always applicable, while 66.7 per cent think it can be applied sometimes. However, 8.3 per cent of students think that it would only be applicable from time to time. Even so, common thinking is positive.

   Some of the students' comments were as follows:
   - ✓ It could also be applied specifically to teenagers to make the lesson more fun and keep them engaged.
   - ✓ Depending on the students' tastes, I think they could attend the lesson in a different and fun way.

4. To the question: Has this learning approach made you feel more responsible for your class and the learning process?

The majority of the answers, 41.7%, said that this learning approach contributed a lot to making them feel more responsible for the class and the learning process, and 20.8% said that it contributed a little. 37.5% of the answers were neutral, but there were no negative answers. According to this, we can also summarise that the general feeling is positive, as with the other questions.

Results for group 2: