Pedagogical strategy for AR
 Requirements Analysis Document | RAD and pair learning

|	
Financial project	PT01-KA220-HED-000032018 Co-funded by the Erasmus+ Programme of the European Union
Project logo	NEW PEER AUGMENTED REALITY APPS
Coordination Project	ATLÂNTICA UNIVERSITY INSTITUTE
Partner's logo	STEPP · IdEF ΚΑΤΑΡΤΙΣΗ ΚΕΝΤΡΟ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗΣ 1 · PRIMERFRAME ESCUELA DE ANIMACIÓN Y VIDEOJUEGOS · Clictic e-learning services
PR3 Coordination Logo	eurofortis

Model Requirements Analysis Document (RAD) | Pedagogical Strategy for RA and Peer Learning

The Requirements Analysis Document is a Design Model that aims to highlight the process by which the requirements of the Pedagogical Strategy for AR and Peer Learning are focussed in the representation of the European Framework for the Digital Competence of Educators - DigCompEdu. To this end, this document will develop a framework that aims to detail how digital technologies can be used to improve and innovate education and training.

This DAR shows how the Pedagogical Strategy for AR and Peer Learning will be structured to fulfil the requirements for completing the NPEER TOOLKIT. This competence framework will explain the skills and knowledge educators need to use AR educational applications inside and outside the classroom. It will extend the European framework of digital competences for educators.

It is the main reference for the development of the practice and must therefore contain all the information necessary for the NPear Project team to complete this stage of the project.

This RAD document is carried out in four phases. The first is a preliminary narrative discussion in which the general state of the art of this scientific subject area (pedagogical strategies) is addressed. In the second phase, the aim is to briefly discuss the learning approach of AR-based teaching. The specific pedagogical approach aims to show how the strategy can be developed beyond the project by the consortium partners and the community in general. In the third phase, it should contain the detailed research - AR educational competences framework to specify the competences that educators need to successfully implement AR-based learning approaches in their practice, and in the last phase - the fourth phase, this document will present the AR educational competences assessment tool, allowing any educator to assess their competences and get recommendations on achieving the missing competences.
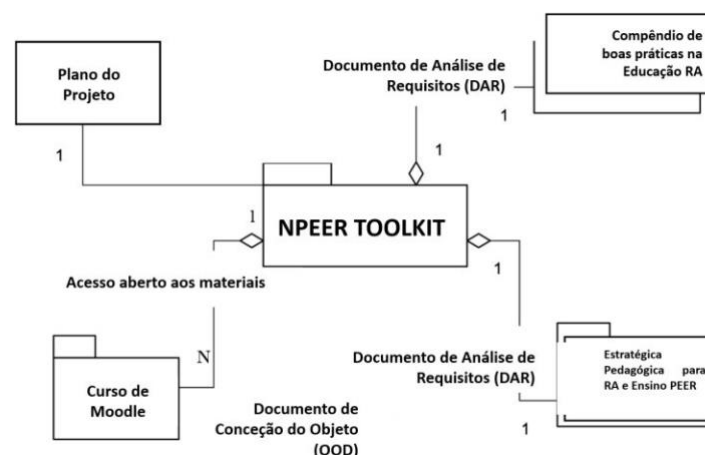
This template is an annotated outline of the NPEER TOOLKIT design document developed for the New Peer Augmented Reality Apps project. The document has been reduced to simplify this task, while retaining the main components and providing a general idea of a project definition report.

Team name - Biedrība Eurofortis (E10114915 - Latvia) | Project title - NEW PEER AUGMENTED
REALITY

PR3 | Pedagogical Strategy for AR and Peer Learning

Project Number: PT01-KA220-HED-000032018

Date: (mm/dd/yyyy)

Table of Contents

1. INTRODUCTION

1.1 Objective

This concept paper describes, identifies and defines the strategic components for a pedagogical application of physical education in AR. This outcome is centred on identifying and designing approaches that enable educators to extend their teaching practices while using innovative AR technology. It analyses instructional strategies designed to increase motivation, concentration, participation and comprehension when using AR as a form of multimodal perspective. The analysis includes an existing framework that can enhance students' attention in combination with AR.

Peer learning is advantageous in situations where students can help each other, explore new ways of learning through technology and collaborate even in periods of social distancing through available technologies. Peer learning as an interdisciplinary pedagogical framework that promotes team building, solidarity and empathy in the educational context will be explored and suggestions made.

The educational AR competency framework explains the skills and knowledge educators need to use educational AR applications in and out of the classroom. The self-assessment tool is designed to give educators an overview of AR skills according to the competency framework. It will thus highlight the skills that educators are strong in and motivate them to work on improving their digital skills.

1.2 Scope

The analysis of the pedagogical strategy for educational AR is focusing on the technological and pedagogical requirements that are "mandatory" in any educational context. It includes the peer learning approach to AR-based education. The aim of the analysis is to develop collaborative and peer learning with AR. It also provides direct guidance for educators. This focus on a specific pedagogical approach aims to show how the strategy can be developed beyond the project by the wider community.

The aim is to extend the EU's digital competence framework to specify the competences that educators need to successfully implement AR-based learning approaches in their practice. The framework provided, as an assessment tool, allows any educator to evaluate their competences and get recommendations on where to obtain the competences they lack.

1.3 Description General

This document will compile the literature review on the use of Augmented Reality in education with the aim of promoting its use in conjunction with the peer tutoring methodology in Physical Education.

This document consists of four parts:

1. Introduction to the project and the document.

2. Pedagogical strategy for AR. Here you'll find an overview of augmented reality, an analysis of pedagogical strategies, an analysis of the peer learning approach to AR-based education and peer learning.

3. Framework of educational competences. In this chapter, the proposed new educational framework is described and supported.

4. Assessment tool for AR educational competences. The self-assessment tool is designed to provide educators with an overview of AR competences according to the reference framework.

2. PEDAGOGICAL STRATEGY FOR AIR

Analysing this section will help to understand pedagogical approaches for students. This includes reviewing the description of augmented reality, reviewing pedagogical strategies, including the important qualities in learning experiences and content, reviewing the peer learning approach to AR-based education and peer learning. The review supports the development of the competence framework in the field of education.

2.1 Augmented Reality

Augmented reality (AR) refers to a system that projects computer-generated objects, such as texts, images, videos and 3D objects, onto the user's perception of the real world (Danakorn Nincarean Eh Phon, 2014). Since AR is considered to be a modification or extension of virtual reality (VR), there is a strong relationship between AR and VR. Both systems have aspects in common, including interactivity, immersion, information sensitivity and navigation capabilities (Danakorn Nincarean Eh Phon, 2014).

AR can be used and has its potential as an auxiliary learning tool, increasing student participation. It helps students understand information better, compared to traditional teaching, which often focuses more on memorisation and repetition. Thus, the inherent concept of augmented learning appeals to young learners (BAGGA, 2021). It is already clear that Augmented Reality (AR) is one of the fastest growing and evolving technologies. It provides an enriched view of the physical world by adding layers with contextually useful information, presented visually or by stimulating other senses through portable devices (Alexandra Klimova, 2018). Augmented reality is characterised by its correspondence to nature, its cognitive, metaphorical, diverse, interactive and anthropomorphic nature (Oksana V. Klochko, 2020). The results of the research indicate that the majority of teachers reacted favourably to the idea of using augmented reality in their professional work. Teachers can design and produce effective learning resources using AR technology.

2.2 Pedagogical strategies

Many of today's schoolchildren will be working in new types of jobs that don't yet exist, most of which will probably value digital and socio-emotional skills more highly (World Economic Forum , 2020). It is therefore essential that teachers and trainers adapt to real needs.

Pedagogical strategy is the theory and practice of teaching, pedagogy refers to the methodology and process of how instructors approach teaching and learning using a specific curriculum with specific goals in mind (Montclair state university, n.d.).

In post-digital educational research, there is a shift from pedagogy (teacher-centred education) to andragogy (learner-centred education) and then to heutagogy (self-designed and determined learning through formal and informal pathways), (Parslow, 2010). Thus, the N-Pear project aims to make it easier for students to work with their peers and with technologies to gradually become self-determined learners in a hyperconnected society.

In order to provide students with the knowledge and skills needed to build a more diverse, harmonious and productive society, educational methods have to change (World Economic Forum, 2020). Teachers endeavour to make their lessons interactive, exciting and engaging. They do this so that they are well received by their students. As technology is developing rapidly, it is essential and important to inform teachers, scientists and policy-makers about new adapted learning methods, learning objectives and assessment criteria. It is important to understand the knowledge, skills and competences required in the field of Augmented Reality.

Pedagogical strategy for AR
Requirements Analysis Document | RAD and pair learning

Research indicates that because AR is being more widely recognised, especially by education researchers, its potential may be even greater. AR can provide students with a variety of advantages with excellent teaching methods, which can result in successful learning experiences (Danakorn Nincarean Eh Phon, 2014).

According to recent research, the benefits of using augmented reality in educational environments can be summarised as follows:

- greater motivation: users are more eager, interested and committed to dealing with new technologies, as well as teaching and learning content, compared to non-augmented reality methods.

- increased attention and concentration: this benefit has to do with the attention users pay to the technology and, consequently, to the teaching and learning content.

- greater satisfaction: greater satisfaction means that users feel greater satisfaction about the learning process or their educational progress.

- increased student-centred learning: student-centred learning is a teaching concept in which conventional lessons are replaced by new active, self-paced learning programmes. In student-centred learning approaches, students are more self-responsible for their own progress in education, and educators act as facilitators who enable students to learn independently and individually.

- improved collaborative learning: studies indicate that AR applications have improved collaborative learning by providing new forms of communication and co-operation.

- greater accessibility to information: AR applications can improve and facilitate access to information on teaching and learning content.

- memory improvement: memory improvement refers to the retention of knowledge acquired while using an AR application.

- Improved learning curve: An improved learning curve effect refers to the fact that students learn faster and more easily with AR applications compared to non-AR applications (Augmented assessment, 2023).

To define high-quality learning, the World Economic Forum has established eight important qualities in learning experiences and content. These are:

1. Global citizenship skills: Include content centred on awareness of the world in general, sustainability and playing an active role in the global community.

2. Innovation and creativity skills: Include content that promotes the skills needed for innovation, including complex problem solving, analytical thinking, creativity and systems analysis.

3. Technological skills: Include content based on the development of digital skills, including programming, digital responsibility and the use of technology.

4. Interpersonal skills: Include content centred on interpersonal emotional intelligence, including empathy, cooperation, negotiation, leadership and social awareness.

5. Personalised and individualised learning: Moving from a system in which learning is standardised to one based on the diverse individual needs of each student and flexible enough to allow each student to progress at their own pace.

6. Accessible and inclusive education: Moving from a system in which learning is confined to those who have access to school buildings to one in which everyone has access to learning and is therefore inclusive.

7. Problem-based and collaborative learning: Moving from process-based content delivery to project and

problem-based content delivery, requiring collaboration between peers and better reflecting the future of work.

8. Lifelong and student-orientated learning: Moving from a system in which learning and skills decline throughout life to one in which everyone continuously improves existing skills and acquires new ones based on their individual needs (World Economic Forum , 2020).

To create a functional and up-to-date pedagogical strategy, it is important to use formal and informal educational practices that adapt competences to a complex and changing world. People's behaviour has been directly affected by the social changes brought about by the technological revolution in communications (Laura Icela González-Pérez, 2022).

The potential of digital technologies to improve student-centred pedagogical approaches and increase students' active participation in and ownership of the learning process is one of their main benefits for education. Thus, while studying a subject, experimenting with various possibilities or solutions, understanding the connections, coming up with original solutions or producing an artefact and reflecting on it, for example, digital technology can be used to support students' active involvement (World Economic Forum, 2020).

Training in sophisticated thinking skills, including scientific, critical, creative, innovative and systemic thinking, as well as building interpersonal relationships and habits of wellbeing, mental health and well- being, will contribute to an education that promotes problem-solving and attention to social needs (Laura Icela González-Pérez, 2022). The use of smart and disruptive technologies in education to promote the integration of transversal and soft skills is a challenge. It is expected that in the future, training and learning development can be improved through the use of AR technologies, so there is a need to improve teaching using up-to-date technologies (Sabrina Romina Sorkoa, 2019).

2.3 Peer learning approach to AR-based teaching

Modern communication tools can support schooling. Peer learning and AR work together to connect students in the classroom, so they can share ideas and look at problems from different angles. Game-based learning helps foster innovative thinking. By generating original interactive stories, augmented reality (AR) helps pupils become competent users of digital technology. Promoting mentoring skills can help children establish positive relationships with others and consider alternative points of view, which can support and enhance other future talents.

The learning approach must be applicable to the current and future generations. It was emphasised that fast technologies will provide jobs for the future that does not yet exist. Therefore, adaptability and technological literacy are highly valued.

By using appropriate pedagogical strategies, AR can provide students with numerous benefits that can lead to effective learning experiences.

2.6 Peer learning

By utilising appropriate pedagogical strategies, AR can provide students with numerous benefits that can lead to effective learning experiences (Ping Zhang, 2017). Peer learning is a mutual learning and training strategy that involves participants of the same level engaged in collaborative learning (Indeed Editorial Team, 2022).

The process includes teaching each other, sharing questions, examples, solving a problem, working to develop a collective understanding or even recreating work based on a project. This approach to learning is becoming increasingly popular in education and vocational training because it has the potential to offer cost- effective,

efficient and enjoyable options for skills acquisition, knowledge retention and creative thinking. As a process, it improves engagement, autonomy and empowerment, which are key competences for learning for a living. The power of P2P is the social pressure that creates etiquette and shared values, the micro-help and peer support that help students overcome challenges. Students learn a lot by explaining their ideas to their peers and participating in activities where they can learn from their peers (Palvia, 2021). Peer tutoring, from a student's point of view, offers the opportunity to relate to their peers and to promote students' initiative to take responsibility for their own learning and their academic and social growth (Clare Woolhouse, 2020).

Augmented reality will soon have an impact on the modern learning cycle in the education sector, as generations of students need to be adapted. The well-known Generation Z is our first true generation of digital natives. Born into a technological world, information has been placed at their fingertips and the use of social media has become the norm (Navigate 360, 2022). Generation Alpha marks a new digital era, given the speed and exponentiality of technological advances. Given their great diversity, students will need support for socio-emotional learning more than ever. With the development of smartphones, Augmented Reality is being applied to a wider range. Augmented reality can transform a normal classroom into an immersive experience (D.Roopaa, 2021).

As already mentioned, children must be equipped to contribute productively to future economies and to contribute as responsible and engaged citizens in future societies. The most important competences are defined as global citizenship, innovation and creativity; technological literacy; and interpersonal skills (World Economic Forum , 2020).

New communication technologies can facilitate education. AR, in combination with peer-to-peer learning, can connect children in classrooms, allowing them to exchange ideas and learn about challenges from different perspectives. Playful learning can enable the acquisition of innovation skills. The use of AR helps pupils develop fluency in the language, using digital technology, creating unique interactive stories. Promoting mentoring skills can help children develop healthy relationships with others and consider different points of view, which can complement and enhance other future skills (World Economic Forum , 2020)**.**

3. FRAMEWORK OF EDUCATIONAL COMPETENCES

Competences can be described as a combination of knowledge, skills and attitudes applied appropriately to a context in order to achieve a desired result.

Digital Competence Framework for Citizens (DigComp 2013 by the European Commission) The aim is to be a tool to improve citizens' digital competence, help policy makers formulate policies and plan education and training initiatives to improve digital competence. It is used as a tool to identify and describe the main areas of digital competence. DigComp identifies 5 key components of digital competence (European Commission, 2016).

Table 1: The Digital Competence Framework for Citizens (Adapted from Vuorikari, 2016)

It is a very valuable tool to serve as a basis for educators' AR frameworks. The Digital Competence Framework for Citizens presents basic understanding and competences for teachers and students.

We are currently adopting various frameworks and structures to educate the Alpha generation (i.e. the current generation born between 2010 and 2024). Growing up in a digital environment, with all knowledge just a click away, will not only affect their experiences, but will define the way they interact with their peers. The main characteristics are: Hyper-connected, independent, visual and technological. Diverse (lifestyles and points of view) (Iberdrola, 2022). In addition, the main challenges can be named as: Reduced attention span and concentration, less time to socialise, less development of creativity and imagination, less ability to achieve happiness (Iberdrola, 2022). The Eduniversal Evaluation Agency (EEA) proposes that the Alpha generation's approach to learning, promoted by their early introduction to intelligent tools, will be more assimilated to AI robots and quantum computers than to conventional human reasoning (Eduniversal Evaluation Agency, 2019). Furthermore, it is stressed that highly personalised and targeted learning experiences will become fundamental.

The above characteristics are being considered for the development of RA's competences framework in the field of education.

By understanding the potential applications of AR in education, teachers can begin to design learning experiences that capitalise on this technology. However, the use of AR in education is currently in its infancy and most teachers are unfamiliar with how to use this technology effectively in their classroom. It is essential to understand the methodologies for using AR in the classroom and to analyse specific examples of how this technology can be used to improve teaching and learning.

Integrating augmented reality into the classroom requires careful planning and specialised knowledge to ensure

that the technology is used successfully for the benefit of both students and teachers. AR has vast potential implications and numerous benefits for improving teaching and learning environments, as it can:

- involve, stimulate and motivate students to explore the materials in the lesson from different angles;

- help teach subjects where students can't get real first-hand experience;

- strengthen collaboration between students and teachers and between students;

- encourage creativity and imagination in students;

- helping students to take control of their learning at their own pace and in their own way;

- create an authentic learning environment suitable for different learning styles (Augmented assessment, 2023).

RA's educational competences framework

1. **Technological literacy:** the ability to use, understand, manage and analyse technology safely, effectively and responsibly. This literacy includes using technology to evaluate, create and integrate information. As well as using different digital tools to discover, create, review, evaluate and utilise information. The teacher must have a good understanding of the characteristics and technical capabilities of the equipment before integrating it into the classroom.

2. **Communication and collaboration:** Communication is the exchange of information in order to reach a better understanding. Collaboration, on the other hand, is the exchange of information to create or realise something together. Communication and collaboration require respectful forms of co-operation.

3. **Peer mentoring:** exchange of knowledge, experience and goodwill. The mentoring process includes five phases: planning, analysing, developing, implementing and evaluating. All phases are crucial to achieving better results.

4. **Playful and experiential:** the ability to learn in a playful way will increase the learner's motivation and commitment. Learning processes that are experiential will lead to better knowledge and a broader understanding of the principles of learning.

5. **Active participation and responsibility:** Peers act to achieve results and take full responsibility for the actions undertaken. Can analyse and identify opportunities and challenges.

4. EDUCATIONAL AIR COMPETENCE ASSESSMENT TOOL

The self-assessment tool provides educators with an overview of AR competences in line with the framework. It will highlight the competences in which educators are strong and motivate them to work on improving the digital competences in which they are weaker.

The questionnaire should be answered by the teacher who uses or is planning to use AR tools in teaching. The answers are yes or no.

Evaluate your capacity for the following statements:

1. **Technological Literacy:** the ability to use, understand, manage and analyse technology safely, effectively and responsibly. This literacy includes using technology to evaluate, create and integrate information. As well as using different digital tools to discover, create, review, evaluate and utilise information. The teacher must have a good understanding of the characteristics and technical capabilities of the equipment before integrating it into the classroom.

    1.1. I can use AR tools effectively in my classroom!
    1.2. I can help and explain how to use AR technology in class!
    1.3. I use different digital tools in my lessons!
    1.4. I tried out the AR tool before the lesson!

2. **Communication and collaboration:** Communication is the exchange of information in order to reach a better understanding. Collaboration, on the other hand, is the exchange of information to create or realise something together. Communication and collaboration require respectful forms of co-operation.

    2.1. I get feedback from students after using AR tools in class!
    2.2. I get involved in discussing the study process in class!
    2.3. I ask the students to suggest new digital tools to use in class!
    2.4. Involvement to discuss the study process!

3. **Peer mentoring:** exchange of knowledge, experience and goodwill. The mentoring process includes five phases: planning, analysing, developing, implementing and evaluating. All phases are crucial to achieving better results.

    3.1. I get the students to help each other in pairs or groups!
    3.2. Together with the students, we plan the activities for the lesson!
    3.3. I get the students to explain the new skills they've learnt to others!
    3.4. I give the students surveys to evaluate the study process!
    3.5. I give students the chance to assess the content of their studies!
    3.6. Together with the students, we work on suggestions for how to develop the content of the study!

4. **Playful and experiential:** the ability to learn in a playful way will increase the learner's motivation and commitment. Learning processes that are experiential will lead to better knowledge and a broader understanding of the principles of learning.

    4.1.   Students can experiment in class!

    4.2.   Students can choose how they learn new content!

    4.3.   Students are free to use different tools in the learning process!

5. **Active participation and responsibility:** Peers act to achieve results and take full responsibility for the actions undertaken. Can analyse and identify opportunities and challenges.

    5.1.   The students analyse the seized material!

    5.2.   Students support each other in the class!

    5.3.   The students play the role of trainers and trainees in the class!

    5.4.   The students define the learning plan themselves!

    5.5.   Students analyse the challenges prior to the study process!

Bibliographical references

Alexandra Klimova, A. B. (2018). Existing Teaching Practices in Augmented Reality. *7th International Young Scientist Conference on Computational Science* (pp. 5-15). St Peterburg: Elsevier B.V.

Augmented assessment. (2023, January). *Augmented assessment*. Retrieved from A set of innovating tools: https://augmented-assessment.eu/a-set-of-innovating-tools/

BAGGA, D. (2021, January 8). Augmented Learning (AR) Teaching Methodologies.

Clare Woolhouse, L. J. (2020). *Mentoring in Higher Education.* Springer Nature Switzerland.

D.Roopaa, R. G. (2021). Revolutionising education system with interactive augmented reality for quality education. *Materialstoday: Proceedings*, 3860-3863.

Danakorn Nincarean Eh Phon, M. B. (2014). Collaborative Augmented Reality in Education: A Review. *2014 International Conference on Teaching and Learning in Computing and Engineering.* IEEE Computer Society.

Eduniversal Evaluation Agency. (2019, June). Eduniversal *Evaluation Agency*. Retrieved from Generation alpha an ieducation for an igeneration: https://eduniversal-eea.com/news/Generation-alpha-an-ieducation-for-an-igeneration.html

European Commission (2016). *The Digital Competence Framework for Citizens.* Luxemburg: Publications Office of the European Union. Retrieved from https://www.digitalskillsaccelerator.eu/learning-portal/online-self-assessment-tool/

Iberdrola. (2022). *Iberdrola*. Retrieved from Alpha generation: https://www.iberdrola.com/talent/alpha-generation

Indeed Editorial Team (2022, December). *Indeed*. Retrieved from https://www.indeed.com/career-advice/career-development/peer-to-peer-learning

Laura Icela González-Pérez, M. S.-M. (2022). Components of Education 4.0 in 21st Century Skills Frameworks: Systematic Review. *Education 4.0: Mobilising for Sustainable Development*.

Montclair state university. (n.d.). *Montclair state university*. Retrieved from Teaching-and-learning/pedagogical-strategies-and-practices: https://www.montclair.edu/itds/teaching-and-learning/pedagogical-strategies-and-practices/#:~:text=Generally%20defined%20as%20the%20theory,with%20specific%20goals%20in%20mind.

Navigate 360. (2022). *Navigate 360*. Retrieved from Gen Z and Gen Alpha in the Classroom: The Importance of Digital Learning: https://navigate360.com/blog-news/the-importance-of-digital-learning-gen-z-and-gen-alpha-in-the-classroom/

Oksana V. Klochko, V. M. (2020). Methodological aspects of using augmented reality for improvement of the health preserving competence of a Physical Education teacher . *International Workshop on Augmented Reality in Education*, 108-128.

Palvia, S. C. (2021). Online education next wave: peer to peer learning. *Journal of Information Technology Case and Application*.

Parslow, G. R. (2010). *Commentary: Heutagogy, the practice of self-learning.* Biochemistry and Molecular Biology Education.

Ping Zhang, L. D. (2017). *Peer Instruction in introductory physics: A method to bring about positive changes.* PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH.

Sabrina Romina Sorkoa, M. B. (2019). Potentials of Augmented Reality in Training. *9th Conference on Learning Factories 2019* (pp. 85-90). Procedia Manufacturing .

Vuorikari, R. K. (2016). *European Commission*. Retrieved from DigComp Framework: https://joint-research-centre.ec.europa.eu/digcomp/digcomp-framework_en

World Economic Forum . (2020). *Schools of the Future: Defining New Models of Education for the Fourth Industrial Revolution* . Geneva: World Economic Forum .