Co-funded by the
Erasmus+ Programme
of the European Union

PROCEEDINGS OF THE IPEAR-CONFERENCE

ATHENS, GREECE

ORGANISED & ACCOMODATED BY AKTO ART & DESIGN COLLEGE
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Foreword

This publication presents findings from the iPEAR Conference, which took place from May 30 to June 1, 2023 in the European Parliament – Athens Information Office in Greece, Athens.

The iPEAR Conference, focusing on Inclusive Peer Pedagogy and Augmented Reality, facilitated the gathering of educators, instructional designers, learning technologists, and student teachers. Its purpose was to foster the exchange of research, practical experiences, and pedagogical concepts in the realm of Technology Enhanced Teaching.

The iPEAR Conference marked an important milestone as the Multiplier Event for the iPEAR - Inclusive Peer Learning with Augmented Reality project, supported by the European Union's Erasmus+ program.

The iPear project targets higher education (educators and their students) and maps the educational use of AR, focusing on collaborative and peer learning approaches. It intends to facilitate the adoption of AR in education by creating open access teaching and learning material for educators. It also aims to create and maintain a community of experts in educational AR and other stakeholders that will ensure sustainability of the project and keep the most useful results up-to-date.

Augmented Reality (AR) brings the digital world into the real world. It enhances reality by adding contextual information about surroundings and allowing the user to interact with the real world and the AR experience at the same time. By using AR, an educator can develop new ways to teach educational concepts in the classroom and improve learning outcomes. AR can be used in a range of diverse disciplines including astronomy, geography, physics, nursing, art and design. Nowadays, AR is mainly used in tablet and smartphone applications. Most young people own smartphones and use them to access social platforms, play games and connect with friends and their family. Thus, the combination of smartphones and AR for education is promising and its potential is growing. There are various frameworks that allow experienced users with coding skills to develop AR educational experiences. However, many educators cannot use these frameworks since they do not have the necessary programming skills. Recently, cloud-based platforms which enable rapid and simple creation and deployment of AR

The iPEAR Conference served as a valuable platform for presenting the outcomes achieved throughout the project's three-year duration. Attendees had the opportunity to explore the case studies, delve into the compendium of best practices, and gain insights into the teaching strategy and MOOC that were developed. The conference facilitated productive discussions, encouraging meaningful exchanges among participants interested in the advancement of inclusive peer learning.

Additionally, the event aimed to foster the growth of the European community of practice concerning peer learning with augmented reality. The conference's live streaming from the office of the EU parliament in Athens encompassed all presentations conducted

during the two-day event (Day1: https://www.youtube.com/watch?v=x5Kbc6EPuRM, Day 2: https://www.youtube.com/watch?v=Tm1TVIXM6Wg)

The papers presented in these proceedings start with “Introducing the iPEAR Toolkit of Educational Augmented Reality Tools” by A. Tsinakos, G. Terzopoulos and R. Maloszek. This comprehensive document represents the culmination of three years of meticulous development. This contribution outlines the underlying concept of the toolkit, its evolution as a dynamic resource, and the initial insights gained during the project's duration. Additionally, it provides a succinct overview of the included toolkit components and their key functionalities.

In her paper “Inclusive Peer-To-Peer Learning with Augmented Reality (iPEAR): Reflections on Praxis and Future Trends”, C. Themeli offers reflections on the insights garnered from the iPEAR research, while also envisioning the potential impact of technological advancements like AI on the educational approach. By examining the challenges faced by educators and delving into the advantages and efficiencies of peer learning and augmented reality, the study provides a deeper understanding of this transformative process. Ultimately, the paper underscores the overarching iPEAR motto, which lays the foundation for leveraging AI in advancing higher education for lifelong learning

“The Humanities – Case Studies at FAU” by R. Maloszek presents the findings from case studies conducted at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), a prominent research university with a substantial student body and a robust focus on the humanities. This integration was believed to enrich students' learning experiences, bolster their motivation, and foster greater autonomy in the learning process. These case studies at FAU aimed to substantiate the effectiveness and relevance of the iPEAR approach within the humanities, a field not conventionally associated with AR technology. The paper introduces four specific cases spanning the disciplines of archaeology, media science, teacher training, and sport science.

In her contribution “The iPEAR MOOC”, Iris Wunder aims to offer a concise reflection on the iPEAR MOOC (Massive Open Online Course). The MOOC serves as a platform to disseminate the research and discoveries of the iPEAR project, encouraging educators to explore the iPEAR approach, amalgamating peer learning with Augmented Reality (AR), within a secure and supportive digital space.

““pARty in Europe” - An educational board game enhanced with Augmented Reality”, written by D. Tsompanoudi, S. Aslanidou and G. Terzopoulos, presents the development and execution of an educational board game enhanced with Augmented Reality (AR) functionalities. Collaboratively crafted by a team of students and educators from Eleftheroupolis’ High School in Greece, the game aims to merge the charm of a traditional board game with contemporary technology. The resulting product, "pARty in Europe," is a trivia board game featuring six question categories, distinguished by its interactive board showcasing a large map of Europe, enabling players to activate AR-based queries. Throughout the implementation phase, students engaged in collaborative

endeavors, visualizing their collective achievements and contributing their unique content.

The next paper: “Teaching Ancient Greek in a Secondary School with the support of AR tools: A pedagogical concept” by N. Sfika, aims to offer a pedagogical framework and lesson plan for educators seeking to integrate New Technologies into their teaching practices. N. Sfika, a graduate of the iPEAR MOOC, suggests that by by utilizing specific AR tools alongside peer-to-peer learning, students can be motivated to explore the cultural heritage of Ancient Greece, exemplified by the epic poem "Odyssey" by Homer. This approach promotes active, experiential, and inquiry-based learning, encouraging students to learn through practical engagement and experimentation with AR tools tailored for educational use.

Finally, in their contribution “Building Educational Experiences to promote Peer Learning: The Utilization of Augmented Reality to a Transformative Learning Process through Aesthetic Experience” S. Barakari and A. Dimitra discuss the roles of Peer Learning and Transformative Learning in education, emphasizing collaboration, critical thinking, and the use of aesthetic experiences. It also highlights the emerging significance of Augmented Reality (AR) as a tool for enhancing the learning process and achieving learning goals. The study focuses on designing a transformative learning course integrating aesthetic experiences and AR to promote peer learning. Initial findings and conclusions about the course concept, the impact of AR on peer learning, and the effectiveness of the transformation process are included, along with recommendations for future implementation and utilization.

Erasmus+

iPEAR project is funded by the ERASMUS+ programme of the European Union. This document reflects only the author's views and the Commission is not responsible for any use that may be made of the information contained therein.

Introducing the iPEAR Toolkit of Educational Augmented Reality Tools

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Abstract

The European strategic partnership iPEAR produced a toolkit of educational augmented reality tools. This document is available open source and has been developed over 3 years. This contribution describes the concept behind the toolkit, its development as a document and first experiences that could be gained during the lifetime of the mentioned project iPEAR. It also offers a short introduction into the tools that are included in the toolkit and their main features.

Keywords: Augmented Reality, AR Tools, Toolkit, Head Mounted Display

Introduction

Augmented Reality (AR) is an essential part of the umbrella term Extended Reality (XR) which also includes virtual reality (VR) and mixed reality (MR). AR is one of the main concepts within MR, and it is defined as a combination of reality and virtual reality where virtual objects lie on the real environment surface. Usually, researchers exemplify AR as locating virtual objects in a real environment.

AR is a rapidly growing market amongst ICT technologies. Many industrial use cases of AR in manufacturing, construction, health and trade, as well as a wide spread use in the gaming sector can be found. While the AR R&D community is growing stronger in Europe, the adoption of the technology in education is still fragmented.

The European strategic partnership iPEAR (Inclusive Peer Learning with Augmented Reality) developed a toolkit introducing educational AR applications for educational purpose. The toolkit is part of the project's aim to mainstream the adoption of educational AR by assembling a comprehensive overview of available technological offers, and to facilitate the adoption of AR in education. Following these aims, the toolkit focuses on technological solutions that do not require coding skills, and it entails a how to use section to make it user friendly. The toolkit addresses teachers and educators who are commonly non-technical users.

In line with the project objectives, the toolkit is meant to impact pedagogy and influence peer-to peer-learning. AR tools are not widely used in classrooms yet and have immense potential to make learning alive and visible. Students can upload their preference and their personal pathway to learning sometime even exploring their creative side while enhancing their digital skills. The iPEAR approach of combining peer learning with the AR can make teaching more personally relevant.

The Concept

The toolkit is made up of three sections, with section 1 presenting online platforms for creating AR experiences that can be viewed with a mobile device through an application, while section 2 presents platforms that create WebAR experiences that can be viewed in a browser without the need of a specific application. Section 3 presents AR head mounted displays (HMDs) and specific applications for AR experiences through HMDs.

Additionally, a “Review of Augmented Reality Tools for Building Educational Experiences” maps the territory of AR technologies and contains information and characteristics of available AR tools for educational activities. It describes basic types of educational activities that can be performed with AR.

For each application, a unified guideline is offered that depicts the uses and capabilities of the available tools for building educational AR experiences. Educators can use this information in order to select the appropriate tool for the educational AR experience they are thinking of, based on the guides provided. The guides for each tool include a short description of the idea behind every tool and its functionality, and links to the webpage of the platform and to online tutorials. Additionally, the functionality of selected AR tools is presented in video tutorials developed by the iPEAR project.[1] Finally, the toolkit offers a list of available repositories for 3D models that can be used in AR experiences, as the work with 3D models makes up an important part of the use of AR.

The toolkit is an open educational resource that can be downloaded from the iPEAR project website.[2] Besides it must be noted that the project does not grant the privacy compliance of the tools presented. The use of these tools is at the responsibility of the toolkit users.

[1] https://www.youtube.com/playlist?list=PLhy2nHJciTEA-vvFyh80Re6dNCRJ4CShO
[2] Available on i-pear.eu/resources.

The development of the iPEAR toolkit

The toolkit was developed over a period of three years (2021-2023). In a first version, it focused mainly on mobile AR as it is a core project's objective to provide no- or low-cost and easy-to-use AR tools.

Web AR developed significantly over these three years. At the beginning, the H5P feature AR Scavenger was the only significant player, but soon after the platforms AWE and Blippbuilder offered their own Web AR applications and were included into the toolkit as such.

The section on AR head mounted displays focuses on applications for the Microsoft HoloLens2 as the most important lens in the field of education. It is mainly written by iPEAR partner IMTEL Lab (NTNU, Norway) who develops applications for the HoloLens2 themselves and in cooperation with partners from the higher educational sector in Norway and internationally.

At the beginning of the toolkit development a Google search was conducted by using the search phrases "augmented reality online platform", "augmented reality online toolkit", "AR online platform" and "AR online toolkit". Additionally, websites with catalogues and reviews about AR platforms like Capterra, G2 and Wikipedia were used. This search aimed at locating online AR platforms that do not require coding skills. Google Play was used to download applications on an Android device. Android protects users from inadvertent download and install of unknown applications from sources other than Google Play. It blocks these installs until the user opts into allowing the installation of applications from other sources. Furthermore, when installing applications from other sources, the user does not have access to information such as total downloads, version history, users' ratings and reviews. E.g., the online AR platform Vedils was excluded, since it is provided as an application APK outside the official Play Store; Merge EDU was also excluded, since AR experiences require a physical cube (Merge Cube), for the user to hold digital 3D objects.

Platforms' characteristics were categorized into distinct features including general features and AR features. General features are:

- Web authoring platform: An online web platform designed to assist the user in creating a project and publishing it. It is an essential component to build an AR experience. The user has sign-in credentials for accessing the platform.
- AR Player: Users can view the AR experience by using the AR Player provided by the platform. The AR Player is a mobile application available for free for major mobile operating systems (Android, iOS). In some cases, there is no need for an AR Player since experiences can be viewed in a browser (WebAR) and this makes them OS independent.
- Sample content: Some AR platforms provide demo content to their users. Since AR experiences include mostly 3D objects, many platforms provide available 3D

objects. Some platforms also provide sample content and access to AR experiences created by other users.
- Costs: An important factor when building an AR experience. Additionally, the ability to try the platform for free before purchasing, is also a significant issue since teachers need to test if the platform suits them before purchasing the service.

Features regarding AR technology cover:

- Marker-based AR: As described above, using this feature, an AR application can recognize a set of reference images that are physically located in the world and display digital content over them. AR applications can respond to 2D images in the user's environment, such as books, posters or brochures.
- Markerless AR: As described above, an AR application can understand the real-world environment by detecting feature points, horizontal and vertical surfaces, in order to provide a more natural experience and place virtual objects on flat surfaces like tables or walls.
- Location-based AR: By using this feature, applications can collect location-based information about cell towers and WiFi nodes and display virtual content based on users' location. As an example, a 3D model of a building can be displayed in the place of a real building. The experience can be viewed only from that location.
- Motion tracking: The ability to use data from the gyroscope and sensors of the mobile device. By using this information, an AR application can render virtual content from the correct perspective. Thus, the virtual content can appear as part of the real world giving a more natural outcome to the users.
- Augmented Faces: The ability to detect faces and provide methods to access additional centre and face region poses as well as face mesh-related data. This feature can be used to add content such as hair or hats to a face, like Snapchat does.
- Interactive Buttons/Behaviour Manager: This feature enables the user to connect all the elements that are present in the AR experience. The AR experience is seen as a multimedia application that contains 3D models, videos, images, texts, and audio files. These multimedia elements can be assigned actions and control the whole AR experience. For example, a user can click on a virtual element and watch a video or navigate to another screen. This feature can be used to create educational scenarios through interactive experiences.

The first version of the toolkit was released after the first year of the project. The toolkit was updated twice. A first update included an updated search of tools and the extension to three sections, including a section about AR head mounted displays (HMDs). All information regarding the tools was updated including screenshots of the environments. A second update was based on the feedback of an external peer reviewer and iPEAR MOOC participants. During the second update, all content was updated to cover changes in the tools of the toolkit.

The tools and their main features

A common way to experience AR is through a mobile device (phone or tablet). The user opens the device camera and sees the real world with digital augmentations added to it. The quality of the experience heavily relies on the quality of the camera and the processing power of the device. When a lot of moving 3D augmentations are displayed, the processing power that is needed to be displayed correctly and in high quality is significant. In most cases, AR experiences are provided through **mobile applications**. Many of them require the support of ARCore and ARKit by the device, Google's and Apple's libraries for AR experiences. ARCore supports specific devices, and it is not based only on the Android version of the device.

In the case of **Web AR**, users can view the AR experience by using their browser (PC or mobile device). Web AR experiences are available for PCs if there is a web camera connected to the computer. Web AR experiences are OS independent although they provide less features than AR mobile applications.

All platforms come with complete documentation and tutorial videos. Most platforms support both major mobile operating systems (Android, iOS) or are available for browsers using Web AR technology. An important part of an AR experience are 3D models. Designing a 3D model is not considered an easy task. There are many online resources for obtaining 3D models for teachers to use them in AR experiences and most AR platforms provide a 3D model library for them to use. The toolkit includes a list of the most common 3D repositories.

Platform	Marker-based AR	Markerless AR	Location-based AR	Motion Tracking	Augmented faces	Interactive buttons/ behavior manager
3DBear	-	√	-	√	-	-
AR Scavenger	√	-	-	√	-	-
AR-Media	√	√	√	√	-	√
ARTutor	√	√	√	√	-	√
AWE	√	√	√	√	√	√
BlippBuilder	√	√	-	√	√	√
CoSpaces Edu	-	√	-	√	-	√
CraftAR	√	-	-	√	-	√
Jig WorkShop	-	√	-	√	-	-
Metaverse		√		-	-	√
Onirix Creative Studio	√	√	√	√	-	√
UniteAR	√	√	-	√	-	√
Vidinoti V-Director	√	-	√	√	-	√
ViewAR	√	√	-	√	-	√
ZapWorks Designer	√	√	-	√	√	√

Table 1: AR Features of Online AR Platforms

Some platforms were finally excluded from the unified guidelines of the toolkit as they did not react to our request concerning privacy, and only presented in a simple list: this concerns CraftAR, Jig WorkShop, Metaverse, UniteAR, Vidinoti V-Director, and ZapWorks Designer as we could not be sure that these platforms agree with the use of screenshots and other material from their online tutorials. ViewAR was also removed since the platform changed a lot of the content and now it targets mostly enterprise customers.

The applications described so far imply that users hold their device and view holograms through the screen of the phone, meaning users look at 3D models on a 2D screen – flattening the experience. **Head mounted displays** vulgo lenses offer a much more immersive experience. The toolkit presents the lens that is most relevant for the purpose of education, the Microsoft HoloLens 2. HoloLens 2 is a standalone headset, meaning no additional hardware, such as a computer, is needed for using it. What makes the HoloLens especially powerful is its understanding of the environment and possibility of placing holograms that only the user wearing the HMD can see on specific positions in the world. There are various ways users can interact with the HoloLens 2:

- Gestures: HoloLens can track hands and recognise certain movements and positions as specific actions.
- Gaze: HoloLens can also track eyes, so users are able to perform actions by looking at designated places, e.g., buttons.
- Voice commands: HoloLens has in-built microphone and speech recognition, usually a pop-up showing possible voice commands that can be performed in an application.

A variety of applications are presented in the toolkit that have been developed since the release of HoloLens 2 in 2019. Certainly, there are less than a user would find on an Android/iOS smartphone as the price of the headset is a limitation for development. Most applications for educational purpose have specific topics that they explore. The toolkit lists more open-ended applications for this HMD, namely 3D viewer, Microsoft Mesh App, 3D Graffiti, but also HoloAnatomy, and Nevrolens. It finally goes into the question how to develop an application for HoloLens.

First experiences with the toolkit

The ability of AR to store “enriched” information on the real world and to display it through internet-enabled devices such as mobile phones or lenses means that information can be made available to learners at the exact time and location requested. Moreover, AR technology offers a learning medium that can allow students to play an active role in the learning process. Some general uses of AR in education, independent of the educational field are described in the iPEAR Review of Augmented Reality Tools for Building Educational Experiences, they have been used by educators and learners during the lifetime of the iPEAR project:

Instructors can use **printed material** to add virtual objects and videos to non-interactive books or flyers using marker-based AR. Concepts that can be very difficult to grasp when explained verbally, can be more easily understood when students experience them visually. Unobservable concepts can be viewed in AR through 3D models, helping students grasp concepts that they usually struggle with and prevent them from misunderstanding the information about these subjects. Examples can be augmented books, augmented newspapers, or even augmented art.

With markerless AR, virtual **3D objects** can be placed in the physical environment depending on the environment's real features. This is possible due to advancements in cameras, sensors, processors, and algorithms, capable of accurately detecting and mapping the real-world. Thus, an AR application does not need prior knowledge of a user's environment to overlay 3D content into a scene and hold it to a fixed point in space. This feature can be used by interior designer students to illustrate how they can decorate an actual space with virtual objects like an appliance or a furniture. Students can also view 3D models in the classroom and place them on a surface, using this method. Museums use markerless AR to bolster their physical exhibits with useful 3D digital content that can be placed on a surface near an exhibit.

With AR technology, **field trips** can be enhanced by items and experiences pre-planned by the teacher or even the students. AR experiences can take place in the off-campus physical location. Exploration activities, enhanced tourist guides and places of interest nearby or on a map can add value to the learning experience. Furthermore, AR experiences can display structures as someone living thousands of years ago would see them. These activities can use marker-based AR in order to display content on an interactive map, or markerless AR in order to place a 3D model of a famous landmark on a surface. Furthermore, activities can be triggered by the location of the students, using location-based AR.

A **treasure hunt** or an Escape Room can be realized with the help of AR. These methods of gamified learning can use marker-based AR in order to entertain and motivate students about different topics through various types of questions and clues. A treasure hunt game can also be played outdoors using location-based AR, and students can seek for clues in an open environment. Both activities can engage and entertain students using AR technology.

These methods were used by educators cooperating with the iPEAR project in one way or another.[3] Additionally, participants of the iPEAR MOOC developed concepts based on the iPEAR approach of combining the pedagogy of peer learning with the technology of augmented reality that were based on these methods.[4] At the same time, educators' case studies and participants' concepts were based on the tools presented in the iPEAR toolkit.

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[3] See contributions on case studies presented in these proceedings on page xx and on page 13ff.
[4] See the concept of Natalia Sfika presented in these proceedings on page 53ff.

Conclusion

Online platforms presented in the toolkit sections 1 and 2 allow teachers and educators to create their own AR experiences without any coding skills necessary. Educators and students cooperating with the iPEAR project and participating in the iPEAR MOOC used these platforms to prepare (or let students prepare) their own iPEAR experience, i.e. an AR experience within a peer learning setting.

In conclusion, nowadays, there is a plethora of online AR platforms for teachers to create AR experiences for their students or to instruct their students to develop it as part of an assignment. Most of the online platforms support users by providing supporting material and videos. All of them provide free trial periods so educators can try to use them in the educational process. Some of the platforms are completely free such as ARTutor, Metaverse and Jig WorkShop. Teachers can use the findings of this up-to-date review to select the appropriate AR platform to create an educational experience for their students according to their needs.

Since AR supports many different types of activities, AR experiences in many educational fields can be created. Blended Learning regards blending various forms of student-teacher interaction and emphasizes on the application of digital methods to reach this goal. As AR technology continues to develop and becomes easier for teachers to develop content, the students of tomorrow will likely see more AR experiences in the classrooms of the future. AR has the potential to enrich education, enable teachers, and motivate students to participate in activities.

References

Tsinakos, A., Terzopoulos, G. (2021) Review of Augmented Reality Tools for Building Educational Experiences. Available at https://i-pear.eu/resources/.
Tsinakos, A., Terzopoulos, G. (2023) Evaluation of Educational AR apps and Toolkit with Unified Guidelines for Educators. Available at https://i-pear.eu/resources/.

Inclusive Peer-To-Peer Learning with Augmented Reality (iPEAR): Reflections on Praxis and Future Trends

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Abstract

The short paper aims to briefly reflect on what we have learned from the iPEAR research and look into the future, trying to identify technological advances such as AI and how they could influence the approach. Educators' challenges and the benefits and shortcuts of peer learning and augmented reality were presented to further understand this process. It all comes down to the iPEAR motto that paves the way for future steps using AI to improve higher education for lifelong learning.

Keywords: peer-to-peer learning, iPEAR (Inclusive Peer-To-Peer Learning with Augmented Reality), Augmented Reality (AR), Artificial reality (AI)

Introduction

My first experience with AR started in 2017 with Pokémon Go when my students and I played together to engage with the English language as a motivational trigger. Along the way, we could learn more about geography and exploration: Pokémon Go encourages players to explore their surroundings and find new locations. This can help players learn about different areas, landmarks, and attractions in their community. Biology and ecology since Pokémon Go features a variety of creatures based on real-world animals, which can introduce players to different species and their characteristics. Players can also learn about the importance of conservation and protecting wildlife. Math and strategy since the game involves collecting and managing resources such as Poke balls, berries, and potions. Players can use math skills to calculate the most efficient way to use these resources and develop strategies for catching and battling Pokémon. Social skills were enriched since Pokémon Go can be played with others, either in person or online. This can help players develop social skills such as communication, teamwork, and problem-solving. Physical activity stimulates more engagement since the game encourages players to get outside and move around, promoting physical activity and overall health.

While Pokémon Go may not have been explicitly designed for educational purposes, it can still provide players with a fun and engaging way to learn and explore new topics

along with English language learning. This first peer-to-peer learning experience led me to explore more AR apps, such as HP Reveal. The students in the foreign language centre designed a magazine augmented with videos, songs, and animations. The positive impression of these case studies led me to initiate the iPEAR project.

iPEAR stands for inclusive peer-to-peer learning with augmented reality. It is essential to note here that inclusive means offering options for learning that address students' needs and preferences.

Educators' perspectives on challenges in higher education

Educators in higher education face several challenges that impact their teaching and the overall learning experience for students that the iPEARapproach can address (Themeli, 2023). Some of the key challenges include:

Evolving Technology: Rapid technological advancements require educators to continuously update their skills and adapt to new teaching methods and tools. Integrating technology effectively into the curriculum can challenge educators with limited experience or resources.

Student Engagement: With the increased distractions and competing demands on students' attention, it can be challenging for educators to keep students engaged in the learning process. Finding innovative and interactive teaching methods to capture students' interest and promote active participation is a constant challenge.

Diverse Student Population: Higher education institutions often have diverse students with varying learning styles, abilities, and cultural backgrounds. Educators need to create inclusive learning environments that cater to the needs of all students, ensuring equitable access to education and support.

Assessment and Evaluation: Designing fair and practical assessments that accurately measure students' knowledge and skills can be challenging. Balancing the need for rigorous evaluation with providing timely and constructive feedback to students requires careful planning and consideration.

Limited Resources: Budget constraints and limited resources, such as time, technology, and support staff, can challenge educators. They may have to find creative solutions to deliver quality education despite these limitations, which can be time-consuming and demanding.

Changing Pedagogical Approaches: Traditional lecture-based teaching methods are being challenged by more student-centred and active learning approaches. Educators must adapt their pedagogical practices to accommodate these changes, which may require additional training and professional development.

Research and Publishing Pressure: In many higher education institutions, educators are expected to research and publish scholarly work in addition to their teaching

responsibilities. Balancing teaching, research, and publication demands can be demanding and time-consuming for educators, especially those early in their careers.

Academic Integrity: Ensuring academic integrity and preventing plagiarism and cheating are ongoing challenges. Educators must employ strategies to promote ethical behaviour and academic honesty while using technology tools to detect and deter academic misconduct effectively.

Mental Health and Well-being: Educators and students' mental health and well-being are crucial for effective teaching and learning. Educators may face additional stressors, such as heavy workloads, demanding schedules, and the pressure to perform. They must prioritise self-care and create supportive learning environments that foster well-being for them and their students (Themelis and Sime, 2020).

Keeping Pace with Industry Demands: Higher education must prepare students for the evolving needs of the job market. Educators must stay updated with industry trends and skills required in the workplace, align curricula accordingly, and ensure graduates are well-equipped for employment.

These challenges require continuous professional development, collaboration, and support from higher education institutions to help educators navigate and overcome them effectively. The iPEAR could address some of these issues and offer alternatives.

Peer-To-Peer Learning can address educators' challenges

Peer learning is a practical approach that can help address educators' challenges in higher education. Peer learning involves educators collaborating and learning from each other to improve their teaching practices (Themeli, 2023).

Peer learning can help address financial issues by sharing resources and expertise. Educators can collaborate to develop cost-effective teaching strategies and materials that reduce the need for expensive textbooks and resources. Additionally, educators can work together to identify and apply for funding opportunities that support their research and teaching.

Peer learning can also help address diversity and inclusion issues in higher education. Educators can collaborate to develop and implement strategies that promote inclusivity and address unconscious bias in the classroom. This can include developing training sessions and workshops for faculty and staff on diversity, equity, and inclusion with practical interventions in class and online with a peer learning approach.

Peer learning can also improve student engagement by promoting innovative teaching practices. Educators can collaborate to develop and implement active learning strategies that encourage student participation and engagement. Peer learning can also provide opportunities for educators to learn about new technologies and tools that can enhance student learning outcomes.

Peer learning can help educators keep up with rapid technological advancements. Educators can collaborate to share their experiences with different technologies and identify best practices for incorporating technology into their teaching practices. Additionally, peer learning can provide opportunities for educators to learn from each other and receive support and training on new technologies and tools.

Finally, peer learning can help educators address the challenges of changing student demographics. Educators can collaborate to develop strategies that meet the diverse needs of their students, such as personalised learning and flexible scheduling. Peer learning can also provide opportunities for educators to share their experiences with nontraditional and diverse student populations and learn from each other. Learning with people from different cultural backgrounds could enhance empathy and understanding of 'otherness'.

In conclusion, peer learning can effectively address the challenges educators face in higher education, including financial issues, diversity and inclusion, student engagement, technological advancements, and changing student demographics. Educators can develop innovative teaching practices that improve student learning outcomes and support their professional development by collaborating and learning from each other.

Augmented reality to address educators' challenges

Augmented Reality (AR) is a technology that can also address some of the challenges educators face in higher education. AR involves integrating digital information with the user's physical environment in real-time, which can enhance the learning experience (Themeli, 2023).

AR can enhance engagement and motivation by providing interactive and immersive learning experiences. AR applications can be designed to provide visual and interactive feedback, which can increase student engagement and motivation (Mangal, 2018). AR can also create engaging and personalised learning experiences catering to students' learning styles.

AR can enhance learning outcomes by providing a more dynamic and interactive learning environment. AR applications can create simulations and visualisations that help students better understand complex concepts and theories (Themeli & Prasolova-Førland, 2023). Additionally, AR can provide real-time feedback to students, which can help them identify areas where they need to improve and adjust their learning strategies accordingly.

AR can enhance accessibility by providing a more inclusive and scalable learning environment. AR applications can be designed to provide alternative representations of content, such as sign language or text-to-speech, which can cater to the diverse needs of students, especially in e-learning courses. AR can also be used to create virtual field

trips and other immersive learning experiences that can be accessed by students with physical limitations or who may not be able to participate in traditional learning activities.

AR can encourage innovation by providing new and creative ways to deliver content and engage students. AR applications can create interactive textbooks, virtual laboratories, and other innovative learning materials. Additionally, AR can promote collaboration and teamwork, as students can work together to solve problems and complete tasks in a shared AR environment.

To sum up, AR can be an effective technology for addressing the challenges educators face in higher education, including engagement and motivation, inclusion, learning outcomes, accessibility, and innovation. By incorporating AR into their teaching practices, educators can create more dynamic and interactive learning experiences that cater to the diverse needs of their students.

iPEAR approach case studies (formal, informal learning and research)

Peer learning and Augmented Reality are two innovative approaches that can be used in higher education to enhance the learning experience. Peer learning involves students learning from and with each other in collaborative environments. At the same time, augmented Reality (AR) is a technology that overlays digital information onto the physical world to create immersive and interactive experiences.

Case Study 1: Peer Learning and AR in Anatomy Education

One case study from 2021 found that combining peer learning and AR effectively enhanced the learning experience in anatomy education. The study used a peer learning approach, where students worked together to solve anatomy problems using AR technology. The AR technology allowed students to interact with 3D human body models, providing a more immersive and engaging learning experience. The study found that using AR technology in a peer learning environment improved students' knowledge retention, exam performance, and motivation and engagement in the learning process (Bölek, De Jong, and Henssen, 2021; Themeli and Prasolova-Førland,2023).

Case Study 2: AR in Language Education- https://aridll.eu/

Augmented Reality Instructional Design for Language Learning – ARIDLL project builds a partnership and a professional community to address the need for digital innovation in foreign language learning. The objectives are to enable effective language teaching with

Augmented Reality, build capacity among language teachers to become proficient users and creators of augmented reality educational materials, and improve language education overall. They will develop and publish open instructional design guides for language learning with augmented reality. They will also develop technical recommendations for augmented reality technology design so that it can better support foreign language learning. We will create new augmented reality language learning materials for school pupils, university students, and adult learners studying different languages. They will publish a compendium of practices and scenarios documenting our experience.

Case Study 3: Tourism (informal learning)

With the new COSMOTE CHRONOS application, the Greeks bring history to life for the whole world to experience. Now, the most important monuments of cultural heritage come back to life, whether you are at the Acropolis Rock or anywhere in Greece or abroad. The technology of the future brings our glorious past to the present by utilising cutting-edge Augmented and Virtual Reality technologies and harnessing Artificial Intelligence with the 5G network.

The COSMOTE CHRONOS application operates on all mobile providers' 4G & 5G networks and on WiFi on iOS and Android mobile devices that support ARKit and ARCore. Thus, visitors can admire the monuments of the Acropolis as they were in ancient times, learn everything about their history, and experience a unique journey through their mobile or tablet. In this app, the peer is an avatar named Cleo.

Overall, these case studies demonstrate the effectiveness of combining peer learning and AR in enhancing the learning experience in various educational contexts. By using these innovative approaches, educators can create more engaging and interactive learning environments that improve students' knowledge retention, performance, motivation, and teamwork skills.

Looking into artificial intelligence for peer learning & AR

Peer learning with AR and artificial intelligence (AI) are two technologies that can address some of the challenges educators face in higher education. Peer learning involves students learning from and with their peers, while AI involves using intelligent machines to augment their work with better information categorisation, evaluation and visualisation.

AI can be used to personalise the learning experience for individual students based on their needs, preferences, and learning styles. Peer learning can also provide personalised support, as peers can offer advice and feedback based on their

experiences. By combining AI with peer learning, educators can create a more personalised learning experience that caters to students' needs.

Peer learning emphasises collaboration and teamwork, which AI can further enhance. AI can facilitate group work and collaboration by providing tools and platforms for students to collaborate on projects and assignments. AI can also monitor and analyse group dynamics, providing feedback to students on their communication and collaboration skills (Themelis, 2022)

AI can assess student learning by analysing student data and providing feedback on student progress and performance. Peer learning can also be used for assessment, as peers can provide feedback and evaluate each other's work. By combining AI with peer learning, educators can create a more comprehensive and accurate assessment system that considers individual and group performance.

AI can adapt the learning experience in real time based on student performance and progress. Peer learning can also provide adaptive support, as peers can help and guide struggling students. By combining AI with peer learning, educators can create a more dynamic and adaptive learning environment that responds to students' individual needs. After all, in the peer group, an AI avatar could be helpful to students as assistance.

In conclusion, peer learning and artificial intelligence can be used together to create a more personalised, collaborative, and adaptive learning experience for students. By leveraging both technologies' strengths, educators can address challenges facing higher education, such as personalisation, collaboration, assessment, and adaptability.

Augmented Reality (AR) and artificial intelligence (AI) are rapidly evolving technologies that can be used to create innovative educational experiences. AR is a technology that enhances the real world with computer-generated content, while AI involves using intelligent machines to augment or replace human intelligence.

AR can create personalised learning experiences by overlaying computer-generated content on top of the real world to provide customised information and feedback to students (Wu et al., 2020). AI can also personalise the learning experience by analysing student data and providing tailored recommendations and feedback (Akçayır et al., 2019). Educators can create a more personalised and engaging learning experience catering to students' needs by combining AR with AI.

AR can be used to visualise abstract concepts and complex information by providing 3D models and simulations that students can interact with (Kucuk et al., 2018). AI can also provide visualisations by analysing data and creating visual representations of information (Chen et al., 2020). By combining AR with AI, educators can create a more immersive and interactive learning experience that helps students understand complex concepts.

AR can create adaptive learning experiences using sensors and cameras to track student movements and adjust the learning content accordingly (Chen et al., 2018). AI can also adapt the learning experience in real time by analysing student data and providing personalised recommendations (Akçayır et al., 2019). By combining AR with

AI, educators can create a more dynamic and responsive learning environment that adapts to the needs and preferences of individual students.

AR can be used to create interactive assessments by providing virtual environments for students to complete tasks and assignments (Kucuk et al., 2018). AI can also be used for assessment by analysing student data and providing feedback on student performance (Chen et al., 2020). By combining AR with AI, educators can create a more comprehensive and accurate assessment system that considers individual and group performance.

In short, AR and AI can create innovative and engaging educational experiences that address challenges facing higher education, such as personalisation, visualisation, adaptability, and assessment.

Conclusion

The iPEAR pedagogy has the potential to address many of the challenges educators face and is worthy of future research and further adoption in higher education. IPEARwith Artificial intelligence could be a path to more active and creative exploration to improve life-long learning, and it remains to be investigated. The motto that embraces the perspective of iPEAR is: Connect peers to peers and find technology-enhanced learning (experiential pedagogy and AI) so that skills and content will flourish.

Learning from and with our peers – humans and avatars- is fun, sustainable, and cost-effective. Immersive technologies make it creative, scalable, and memorable.

References

Akçayır, M., Dündar, H., & Akçayır, G. (2019). 'What makes you a better learner? Augmented reality reflections'. Computers & Education, 137, 82-93. doi:10.1016/j.compedu.2019.04.011.

Bölek KA, De Jong G, Henssen D. (2021). 'The effectiveness of the use of augmented reality in anatomy education: a systematic review and meta-analysis'. Sci Rep. 27;11(1):15292. doi: 10.1038/s41598-021-94721-4.

Chen, Z., Fan, S., Wang, H., & Zhang, X. (2020). 'An AI-enabled system for data visualization and analysis in big data era'. Frontiers in Psychology, 11, 582998. doi:10.3389/fpsyg.2020.582998.

Kucuk, S., Kapakin, S., & Goktas, Y. (2018). 'Learning anatomy via mobile augmented reality: effects on achievement and cognitive load'. Anatomical Sciences Education, 11(5), 471-479. doi:10.1002/ase.1742.

Themelis, C. (2022). 'Pedagogy of Tele-Proximity for eLearning. Bridging the Distance with Social Physics'. Routledge. London, UK. https://doi.org/10.4324/9781003270324.

Themeli, C., & Prasolova-Førland, E. (2023). Inclusive Peer Learning Pedagogy with Augmented Reality - iPEAR. Pedagogy and the Human Sciences, 9(1). https://doi.org/10.20415/phs.9.1.2.

Themeli C. (2023) Compendium for good praxis-iPEAR. Available at https://i-pear.eu/resources/

Themeli C. (2023) Strategic pedagogy for iPEAR. Available at https://i-pear.eu/resources/

Themelis, C & Sime, J-A 2020, Mapping the field of digital well-being education: A compendium of innovative practices and open educational resources. Lancaster University. http://www.digital-wellbeing.eu/download/12584/.

Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., & Liang, J.-C. (2020). 'Current status, opportunities, and challenges of augmented reality in education'. Computers & Education, 150, 104073. doi:10.1016/j.compedu.2020.104073.

The Humanities – Case Studies at FAU

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Keywords: Augmented Reality, peer learning, case studies, humanities

Abstract

The European strategic partnership iPEAR organised case studies at all partner institutions to prove the validity of the hypothesis, that the iPEAR approach of using AR in peer learning enhances students' learning experience, fosters their motivation and leads to a greater student autonomy in learning. This paper presents the results of case studies that were carried out at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), a major research university with about 40.000 students and a strong branch in the humanities. Case studies at FAU aim to prove the validity of the iPEAR approach and its applicability to the humanities, as these are usually not in the focus of the AR technology. Four cases are introduced that cover the disciplines of archaeology, media science, teacher training, and sport science.

Introduction

Case studies at FAU took place in 2021-2022 and covered a variety of different subjects, proving that Augmented Reality is adaptable to the most different fields of teaching and learning. FAU case studies covered courses in Archaeology, Media Science, Sport Science and Teacher Training.
Educators were allocated through personal contact by the consortium members of FAU. Before starting the experiment, educators were briefed by the consortium in a two-hours Zoom meeting to prepare them for their role. The briefing took place in February 2021. Here educators learned in more detail about the iPEAR approach and about what expects them when delivering a case study. Basically, the briefing informed them that

- the peer learning aspect is key in the iPEAR approach
- they can use the iPEAR toolkit to inform themselves about adequate educational AR tools
- no coding skills are required
- they might choose a short activity of one or two weeks or a longer one, as they think appropriate

- it is up to them if they let students develop an augmentation or by prepare the augmentation themselves, or even by choosing ready-made AR if it fits their needs
- at the end of the pilot, students are asked to answer a short online survey
- educators are asked to take part in a semi-structured interview by the iPEAR consortium following the activity

Before the start of the course, all educators gave their consent that the information given by them may be used in future reports, academic articles, publications or presentations by the researcher/s of the consortium.
The interviews that were conducted with all educators after the iPEAR intervention were translated into English for further use by the iPEAR researchers. For reasons of data protection, the names of the educators were not revealed. The same for the answers of students in the online survey: students answered it anonymously and their answers were translated into English for the further use of the consortium.

Initially, the iPEAR project planned one semester for the case studies (summer semester 2021). The briefing showed that educators need a longer timeline as the course they wanted to use for the pilot may not take place that semester, but only in the next winter term. In the end, case studies stretched over two semesters covering summer 2021 and winter 2021/22.

Figure 1: Case study process at FAU 2021-2022

The following description of the FAU case studies first outlines the conditions of the course like number of students, subject, level, form (if seminar, lecture or else), followed by a short description taken from educators' interviews. In a third step, a short analysis of the student survey follows. Last not least, a short summary drafts the lessons learned from the case studies.

Case Study 1: Christian Archaeology

The case study took place in a proseminar open to students of any level, from entrants to master students. Through the example of Roman catacombs, a group of nine students was trained on the techniques of Christian Archaeology. Students were supposed to gain knowledge of the monuments, their history, the history of research, and to be able to classify all this with a critical view. For the iPEAR case study, the educator chose a

treasure hunt that was presented to the students before Christmas. In this hunt, students were led through various catacombs, accompanied by an avatar who showed them the next step to take and who at the same time was part of the story telling. The catacombs are available as 3D objects in the Sketchfab repository, and for the purposes of iPEAR the educator advised students to augment them with Sketchfab AR.

Case study 1: **Proseminar Christian Archaeology**

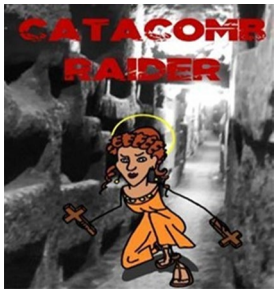
Winter term 2021/2022

9 participants

didactic goal: gain knowledge of the monuments, their history and history of research, to be able to classify them with a critical view

method: treasure hunt with ready-made AR (3D)

Illustrations to the right show the cover of the treasure hunt folder (up) and the avatar that led students through the hunt.



The educator on the course purpose and how the iPEAR case study was included:

> *The course I gave was a proseminar and the proseminar in Christian archaeology actually always has two levels of learning. One is that basic methods of Christian archaeology are taught: how do I actually work on archaeological objects and monuments? And just basic working tools, that is: How do I prepare a paper? How do I get literature? How do I write a paper? How do I discuss objects and monuments? Things like that. The second level is the content of the respective proseminar, because every proseminar has a content level, always a different topic. In my case, it was the Roman catacombs. In other words, the aim is to gain knowledge of the monuments, their history, the history of research, and to be able to classify all this with a critical view. Students should not only learn and get to know facts on this level, but they should also come to question all this critically, to ask themselves questions, to discuss the whole thing also in a group, to endure discussing it and to dare to discuss it. First approaches to a scientific personality, I would say. These are the two levels that are the learning objectives in the proseminar.*
> *[Concerning the iPEAR case study] I practically didn't come up with new learning objectives with the AR applications, but applied them as an enrichment for the learning objectives that I had anyway. In this case: How do I handle AR applications? Especially when it comes to 3D models, this is something that you*

> *can use also in your presentation. That the students will then be able to use. How critical do I have to be with these new AR applications? What opportunities do they offer? What does this mean for the monuments? That was an important point for me. Can students better access the monuments, better visualize them, and better remember them if [they view them in AR]?*

In this case, the educator made use of AR throughout the semester.

> *I always used it when I could. […] I tried – whenever possible – to integrate models in some way. There was also a lecture where a student spoke about the catacombs of Naples [in her presentation] and she then used these models. And then there was this treasure hunt. But it wasn't that I could use AR in every session. I'd liked to, but it's not always possible.*

The peer learning setting with AR was realised in the treasure hunt before Christmas:

> *I did this one Christmas session where I just wanted them to get in touch with each other, get to know each other better. And that worked very well.*

The evaluation of the case study by the educator showed:

> *I can't say that [the use of AR] would have improved anything. I don't think it got any worse. And the evaluation was very positive and I also had the feeling that the students really enjoyed working on it. […] Definitely AR was something that they perceived very positively. Just the models. The 3D models. Of course, this is the hit for archaeology students, as well as for archaeologists. It's just something where we're totally happy that it works now and the students will notice that. There was a great fear that we were going to make plans, that is, layouts. They don't want that. We don't want that either.*

The educator confirms

> *that group work is always great for them. […] There has always been a great commitment, if they were able to do something together. And the AR tools promote that, because it always has something playful and something futuristic. […] They each had their own cell phone and their own plan, but when someone was completely desperate, they said, "God... I'm totally wrong", then somebody close said, "Yeah. Look here again". and "You have to go that way".*

Wrapping up the experience with the iPEAR pilot, the educator uttered:

> *I can imagine that for me, the AR application will continue to run more strongly than the iPEAR approach, to be honest. Because that's just really time-consuming to do. I think I will continue to do group work, also beyond Corona, where it has sometimes been possible. […] In our case, a huge, huge part of the*

proseminar falls on students presentations, because that's what the students absolutely have to learn. Hence, yes. I will continue to do this, but probably not in a large-scale form. […] I would probably have to offer and promote the opportunity for joint learning even more. That's where I'd say I need to improve something.

Five out of nine students answered the survey. In their majority they found the iPEAR approach satisfying or even very satisfying.

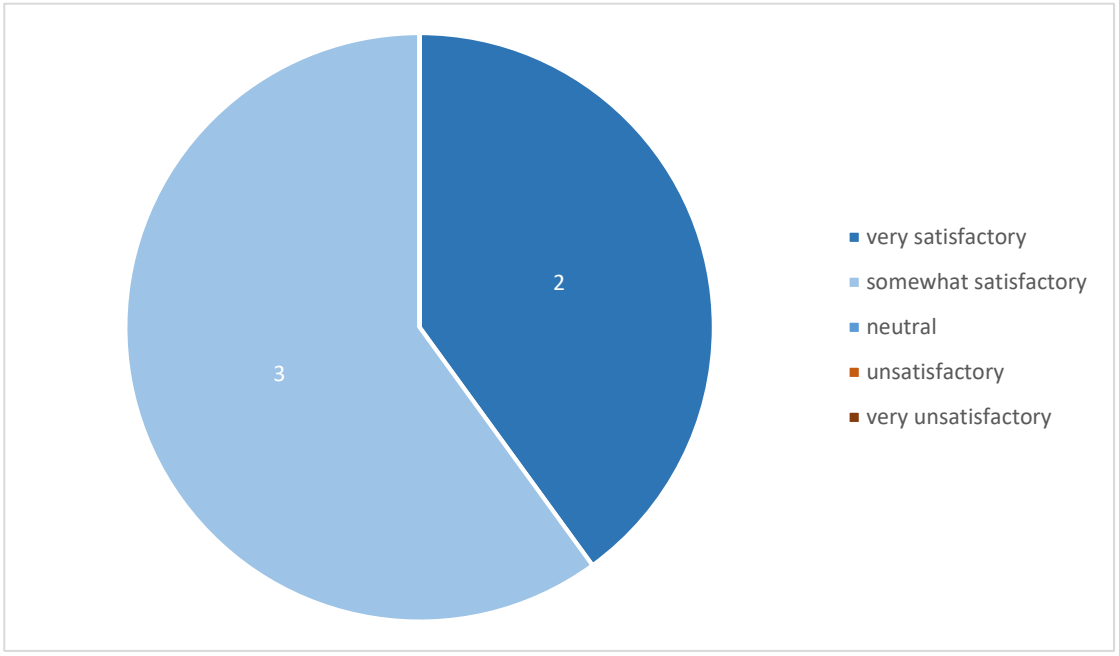


Figure 2: Christian Archaeology students' answer to the question if they found the iPEAR approach satisfying.

1) Student feedback on the approach of peer learning combined with AR tools
Students' answer on the question if they found the approach of peer learning combined with AR satisfactory was yes, though with various shades (3 very satisfying, 2 somewhat satisfying). One student thinks that especially in situations where on-site visits are not possible, the use of AR makes sense. Another confirmed that in the corona semester [this approach is] very useful. A third one stressed that there are more options, free and creative design possibilities, and participants can benefit from different experiences of different groups. But, as one student remarked, it can't replace presence education.

2) Students feedback on teaching each other and sharing content with peers and AR tools
Students feedback on the question if they were more interested in teaching each other and sharing content in the iPEAR intervention ranged from slighty into the positive (somewhat interested) to very interested, as you feel more involved and can actively develop ideas in a wide range of possibilities.

3) Students feedback on the aspect of motivation and empowerment
Students' opinion about feeling more responsible for their learning with the iPEAR approach is a bit more hesitant than the positive opinions on questions 1 and 2. It ranges from somewhat (2) and neutral (2) to not really (1).
One student uttered, that it is not so much a sense of responsibility for one's own learning as being responsible for making others understand the learning material. Self-responsibility in learning is also given in classic learning models. In peer learning and AR, the focus is, in my opinion, on a responsibility to communicate and teach something to your counterpart. (This is a higher motivation for me personally.)
As students did not give feedback on their empowerment, their educator may fill in for them:

> *I think, in the long run, it's incredibly important for our archaeology students to deal with these things, because this is something that's just there now and is coming. And if you leave your studies and you've never dealt with digital applications, you'll simply have worse chances on the job market than you already have. […] We did evaluations. I asked if the students wanted to continue using this application... all kinds of digital applications. And since most of them have actually said: Yes. They want to continue using that. Also for exam preparation, also for lectures and also for the post-preparation of courses. So there is a great openness in any case. And if they really use it, it's also something that strengthens their autonomy […].*

Case Study 2: Media Science

This seminary was a combined approach of two educators representing media studies and educational sciences. About 25 students of both disciplines got an introduction into media theory as well as media didactics with the aim of teaching them both the pedagogical and the media-scientific perspectives from the media. Students were expected to learn from each other using the peer approach in concrete assignments. In small groups, they took a media-theoretical approach of their choice and created a practical e-learning module around it. For this purpose, they had to be familiar with the theory on the one hand and then decide on the didactical approach creating the e-learning module. Students were expected to implement the idea of "their" media theory in the design of the e-learning module. They had time until the end of the semester to deal with a self-chosen media theory and create the e-learning module. Students evaluated this creative learning process at the end of the semester and submitted a documentation, thus giving their educators valuable feedback about the success of this approach.

Case study 2: **Media Science**

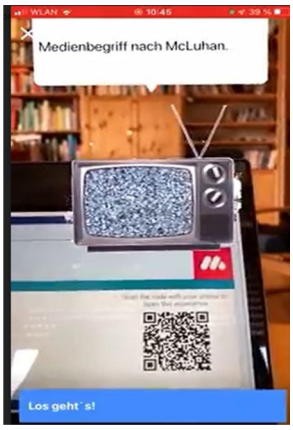
Winter term 2021/2022

5 participants (group AR)

didactic goal: create a practical e-learning module in peer groups that introduce to a media-theoretical approach

method: students develop AR experience

The illustration to the right shows the augmentation that students developed for the purposes of their e-learning module.



> *We have a seminar concept since 2020, which I believe we have already realized four times. The special thing about this is that we bring together students of media studies and students of educational sciences. And the goal is for them to learn something about media theory as well as media didactics together. Therefore, they should develop both the pedagogical and the media-scientific perspectives from the media and, because they come from different disciplines, they should be able to learn from each other using the peer approach. In concrete terms, they choose a media-theoretical approach themselves, meet in small groups and then create practical e-learning modules in the groups with which they introduce this media theory. This means that they must be familiar with the theory on the one hand and then implement it didactically and create an e-learning module on the other. The trick is that we require students to always connect form and content. This means that they should then implement what they say about media theory and media in the implementation and design of the e-learning module. We normally have this flat example for them: If you choose gamification as a theoretical approach, then you should build the e-learning module like a game with game elements.*

For the purposes of the iPEAR case study, one group of students chose to work with augmented reality i.e. to discuss AR in form and content. This group created an e-learning module on the media theory of Marshal McLuhan. Due to his generation, Mc Luhan analysed the effects of media on the example of the television as the dominating visual media technology of his time. The student group decided to “augment” the theory of McLuhan with the technology of AR. They added an example augmentation to their e-module and linked it to the theory of McLuhan, inviting the fictive users of their e-learning modules to think about the impact of “the medium is the message” to the state of the art visual technology AR. For illustrative purposes they created a QR code as a marker and augmented it with an old television showing image noise. The respective page of their e-learning module says:

You are here to learn how to apply McLuhan's theory to media. As an example, we have chosen augmented reality, a medium that is still rather unknown. McLuhan describes a medium as an expansion of the body. Consider where the augmented reality medium might be in the body.

Where can you find it in the body?

Having clarified this issue, the question arises as to what the "message" of AR is. To what extent does AR change the scale, pace, or scheme of people?

Summing up the experience with the iPEAR pilot, both educators uttered that they can very well imagine to use the iPEAR approach again, as it perfectly fits their seminary concept of combining theory and practice and implementing a media theory in a performative way.

> *Understanding this combination of theory and practice and something on the level of media theory but implementing it in a performative way. Augmented Reality and our group concept fit together totally well and I find it really exciting. So without having done it already, but I think the idea is still there for both of us.*

Only two of the five students involved in the AR group answered the survey. Both were satisfied with the iPEAR approach, though maybe not enthusiastic. On the one hand, it was a great experience for them, but on the other hand, in this specific group it was mostly about one student who developed the AR experience and who felt a bit lonely in this role, despite all the group work and group feedback that was there around the technical side of the assignment. As one of their educators uttered:

> *I was happy […] that they said: “We all want to do something with AR.” And after that came the idea of how to use AR and it took them a bit to find a solution. Within the groups, we don’t dictate at all how they have to share their work, because of this peer-learning idea. It is the students who figure this out among themselves and most of the time they really distribute tasks relatively clearly. One has the job to do this section, the other this section and so on, and then they meet regularly and talk about it and give each other feedback. And there it was also the case in this group that a student really had the focus on Augmented Reality. So we have to say in a self-critical way: we actually have a student who really dealt with it, but who also wrote in the documentation that it motivated him and that he tried a lot and took a lot with him and that the feedback from the others helped him to keep going. [But] this individual student then, I think, felt a little lonely. [The student] then created two things in MetaVerse and implemented them [in the learning platform and] the student got himself well into it and the group used it well in the e-learning module. […] How this work then is integrated into the e-learning module, they also discussed it together and we as lecturers also advised them.*

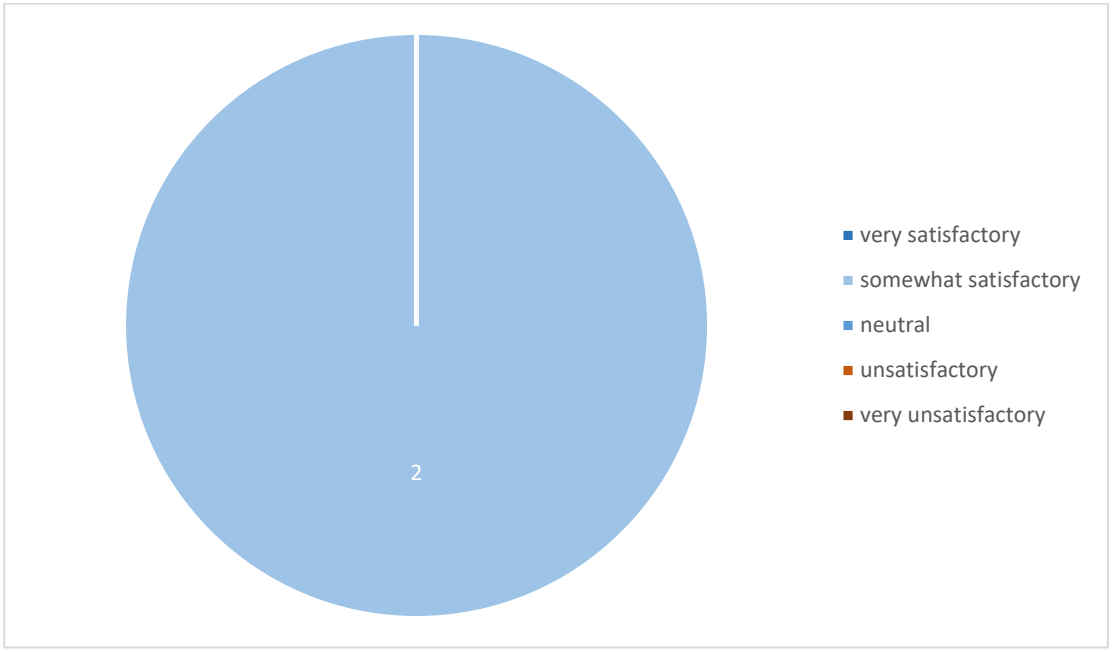


Figure 3: Media Science and Media Pedagogy students answers to the question if they found the iPEAR approach satisfying.

1) Student feedback on the approach of peer learning combined with AR tools

In their feedback to the iPEAR survey, both students decided that for them, the iPEAR approach was "somewhat satisfactory". They uttered that augmented reality was an exciting topic, but it was difficult to use in the context of media studies, thus confirming the impression of their educators that students often feel insecure. Pedagogy students feel insecure about the media theory part that they must get into before thinking of any creative solution for the assignment, and they feel insecure about the practical part of the assignment as they often have little to no experience with media production. But then, towards the end of the seminary, they have made considerable progress and gained autonomy and empowerment:

> *I particularly noticed that pedagogy students often feel insecure with these basics of media theory. For this reason alone, I believe that they are very careful to represent media theory correctly and to understand it correctly. It is the case that creative experimentation gets a bit lost, because the students are busy trying to understand the theory first and to do this theoretical part correctly. At this point, perhaps we could really rethink how we can encourage their creativity a little bit more.*

> *[…] educational scientists often feel very insecure when it comes to media production and have very little experience with it in contrast to students from media studies. For them, I think it has an empowering character, if they have produced something at the end and if they know, "Okay. I can also make something." And probably, if you transfer that to augmented reality, it still has that*

novelty value and that "Now I've not only made an e-learning module on StudOn relatively conservative, but I've actually produced something futuristic myself."

2) Students feedback on teaching each other and sharing content with peers and AR tools
Students rather cautiously decided that they were "somewhat interested" to teach each other and to share content and knowledge with peers, as of course we wanted to show results, but they weren't mature enough to be spectacular. This almost timid self-assessment once more proves the observation of their educators about students' feeling of insecurity, given the complexity of the assignment.

3) Students feedback on the aspect of motivation and empowerment
Answering the survey, students signalled that they did not really feel empowered and more responsible for their learning by the iPEAR approach (1 neutral, 1 not really). But in the written documentation that students delivered at the end of the seminary as part of the assignment, students according to their educators affirmed that applying AR in a peer learning setting motivated them and that the feedback from the others helped to keep going: The group with AR was one of the committed groups, thanks to the iPEAR approach.

Case Study 3: Teacher Training

In a course about teaching and learning with digital media, 14 students learned about the educational features of different digital tools and how to use them in their own teaching as future school teachers. For the purpose of the iPEAR case study, AR was included into these digital tools. As part of the setting, students brought with themselves the different school disciplines that they were studying beyond educational science, among them maths, geography and German language. Beyond the work with digital white boards, question tools, survey tools, and creative learning tools like Actionbound or Bookcreator, the course also introduced into different settings of learning like distance learning and hybrid learning. The tools and methods were applied in different phases of the school lessons like the introductory phase and the repetition phase. In the two weeks that AR was treated, students got an introduction into the technology of AR, to existing tools and their features. Students then had to prepare a little scenario or find a ready-made scenario that they would introduce into their teaching. They were asked to have a special focus on ARtutor as the tool that was specially developed for educational purposes, and on AWE as just another market solution that can be adapted for educational purposes. They could choose any other tool from the iPEAR toolkit or beyond if they wanted to. Students made a short desktop research on the tool or AR experience of their choice, and presented this scenario in the week following the introduction. As part of the peer approach of iPEAR and of the course, as well, students worked in groups of two or three and presented their results as a group. Most groups decided to explore and present ready-made AR, as in some subjects like geography or maths augmentations are already quite widespread.

Case study 3: **Technology enhanced teaching and learning**

Winter term 2021/2022

15 participants (primary & secondary school teacher students)

didactic goal: develop skills in technology enhanced teaching in peer groups

method: students explore tools and present an AR experience

The illustration to the right shows the augmentation that a group of students developed for the purposes of a lesson in school

According to their educator, the iPEAR intervention fit very smoothly into the course concept, as the whole course was about digital tools and working with peers. But also, it was a tool that needed special guidance as it came kind of from far away to the students who did not know from scratch how to deal with it.

> *[Students] loved to work with all those digital tools. They were curious to know different options and methods of working and teaching with digital tools. Teaching in this sense that they were teaching their future pupils. They were very autonomous and empowered [which is true] for the whole course, not only for this AR peer learning setting.*
> *[But] they did not master this subject of AR. […] this needs a lot of guidance for the students […]. It was the most complex tool in a way to use compared with the other tools we had like whiteboards or quizzes and so on.*
> *Eight out of 14 students answered the survey. In their majority they showed themselves very satisfied with the iPEAR approach.*

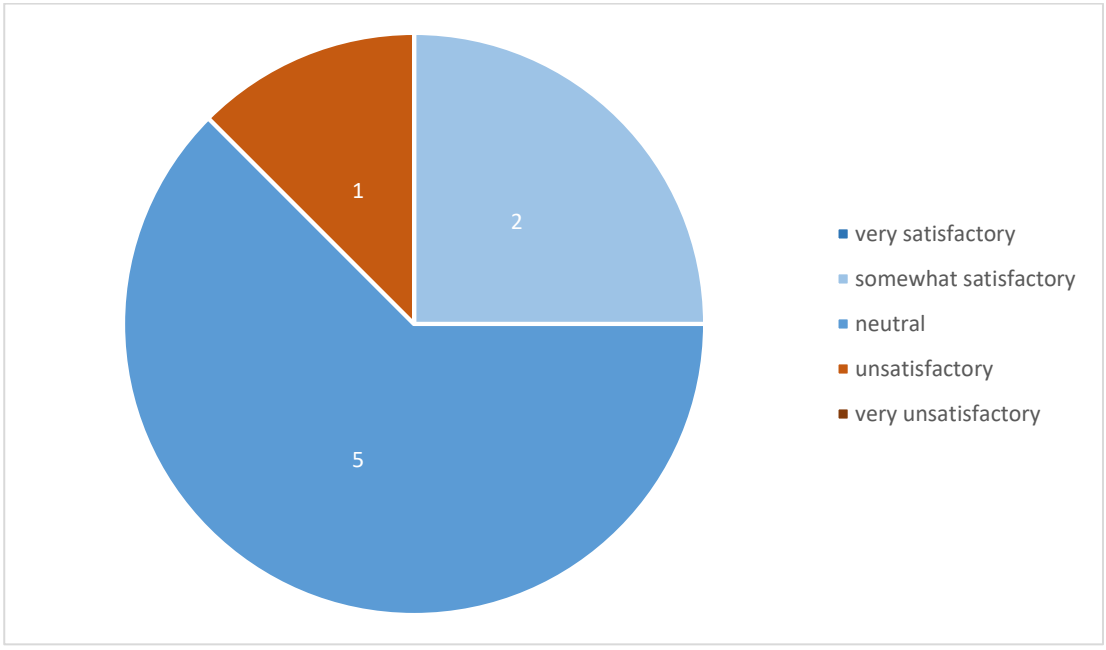


Figure 4: Teacher students' answers to the question if they found the iPEAR approach satisfying in their future school teaching.

1) Student feedback on the approach of peer learning combined with AR tools

In their great majority, students found the iPEAR approach satisfactory. Only one student was not satisfied, not further explaining for what reason. As this course was about teaching and learning with digital means, a general technophobia is excluded in this case. Students uttered that peer learning as well as augmented reality offer a very appealing and meaningful approach for teaching and learning. It is an opportunity to exchange experiences and learn from others that might already know better/are more advanced. But students also see that the necessary technical equipment remains a major challenge. Once these are given, AR offers great visual and auditory new approaches to learning material. [Peer] learning offers more advantages than disadvantages, especially for students and advanced pupils. Students can imagine that the iPEAR approach is helpful in all areas of teaching and learning: Combined with a fascinating technology, the approach is suitable in all areas of teaching and learning. Another student uttered I find AR in many situations just too much and a sensory overload. But in some other situations super helpful. Yet another student received the iPEAR intervention very positively: I find the approach very convincing. I think peer learning is a method that is instinctively rooted in us and therefore has a big potential for great learning success. AR offers the possibility of visualizing abstract things or things that humans can only show at great expense. Unlike many tools we have learned about [in this course], AR has the chance to re-define the learning process.

2) Students feedback on teaching each other and sharing content with peers and AR tools

Students feedback on the question if they were more interested in teaching each other and sharing content in the iPEAR intervention was mixed, some were interested but

others showed themselves neutral or only somewhat interested, because otherwise you get no leading input. One student stressed that it was mainly fun discovering AR [and] nice to be able to share it with others, but the student felt that this was not in the focus of this survey question.

3) Students feedback on the aspect of motivation and empowerment
Students feedback on the question if this learning approach made them feel more responsible for their learning was rather cautious, with the majority answering in the neutral and some slightly to the positive (somewhat) or to the negative (not really). One student (somewhat interested) welcomed this explorative learning and with that more individual responsibility, respectively more opportunities to set own focal points. But this approval came with the relativising remark that this is often still structured by a teacher.

Case Study 4: Sport Science

A group of sport students spent a semester on basketball training, learning the right techniques to improve their play. One lesson was dedicated to a training in peer groups of two or three students teaching each other the right techniques with the help of basketball training app using AR. This pilot remained unfinished since the educator unexpectedly left the university before the analysis could be completed. Students answered the survey, but there was no chance to interview the educator. This is why we lack detailed information on the course objective and the exact task the students had to fulfil.

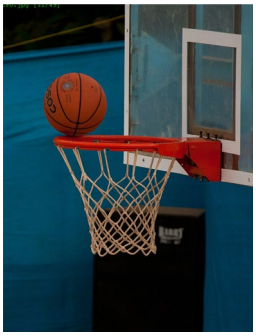
Case study 4: **Basketball training**

Summer term 2021

23 participants

didactic goal: train basketball techniques

method: students use AR app on training techniques with peers



15 out of 23 students answered the survey. In their majority they were content with the iPEAR intervention, as figure 5 shows.

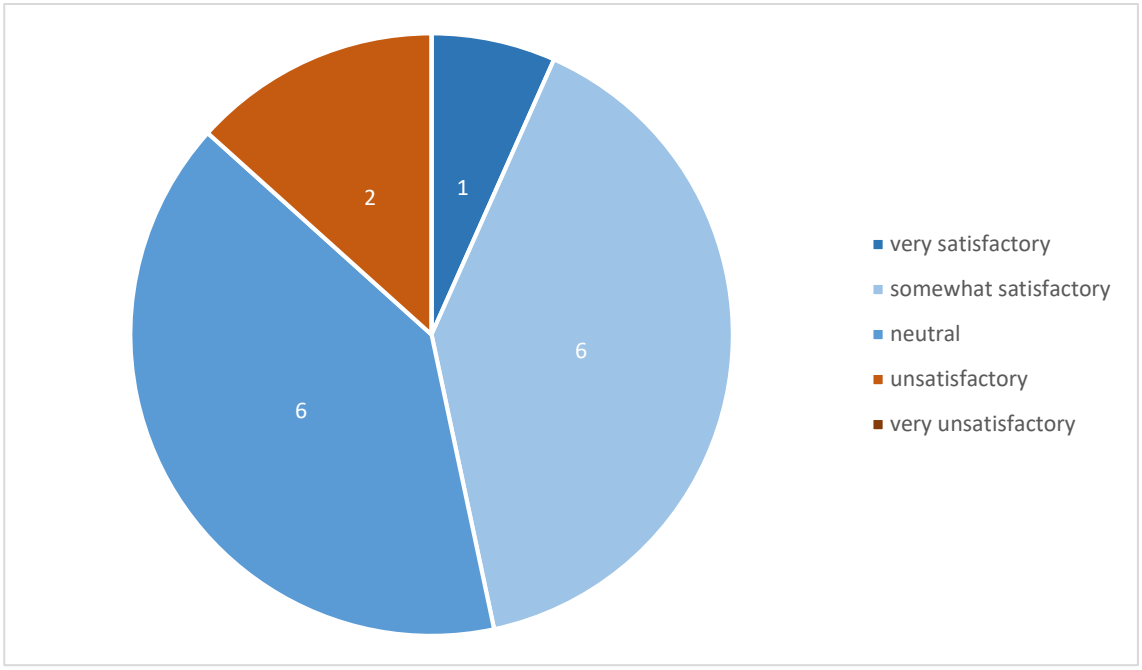


Figure 5: Sport students' answer to the question if they found the iPEAR approach satisfying in their basketball training assignment.

Students in their majority liked the approach of teaching each other with the help of an AR application. They appreciated the effects on their learning motivation and felt empowered to control their own learning process.

1) Student feedback on the approach of peer learning combined with AR tools
Students found practicing with a partner [great] fun because he or she can coach and give tips in addition to the AR tool. You also motivate each other during the exercise. Students found it very helpful and motivating to train and do exercises in small groups. One student focused on the fairness aspect uttering that cheating is not so easy in the game, you get feedback immediately. Everyone gets the same number of times, time is given. The specific AR training app chosen by the educator did not satisfy all students, as one utters in some cases there is no feedback, e.g., when throwing a basket. But this did not seem to diminish the learning effect too much, it was fun anyway. Moreover, the app did not allow to play on one app at the same time: It is good for one or individual teaching units. However, a bit of boredom would creep in in the long run. It would be good if two players could play on one app at the same time (against each other). The aspect of sharing individual training data with the app caused discomfort for some students: The analysis of the workout helps of course to compare with each other, but I have less interest in sharing my training data with others (online) that everyone can see, an aspect that was shared by other students, as well.

2) Students feedback on teaching each other and sharing content with peers and AR tools

In their majority, students stress the aspect of competing each other and having fun in this game-like method of training. As one student put it, for us it was more about comparing than teaching each other, something that certainly is rooted in the competitive nature of sports. Another student confirms that it is fun because you want to achieve success in the form of points and receive direct feedback as to whether the success has been achieved. A third one focuses on the training effect, suggesting that the peer work with the app was useful, because the exercises showed exactly where your personal weaknesses are and in which aspects you can improve.

3) Students feedback on the aspect of motivation and empowerment

Students in their majority confirmed that the approach of learning with peers and using AR made them feel motivated and empowered for their own learning. You get direct feedback, you get an insight into where further exercise is needed. Yet another student confirms that you can follow your learning process and check your performance immediately when the exercise has ended so that there is an error correction immediately afterwards. Students found it very motivating to choose the game independently and play it in a small group. In the words of another student: […] you were motivated in the things you can do and it spurred you on to improve and to fill the gaps that were / are there. The app offered the possibility to practice independently which was helpful for self-motivation because variations are offered and the games trigger the reward system. There were helpful tips from the coach, and students always receive correct feedback. Students admitted that it takes more discipline to practice without the app and they felt motivated by game […] a little more than in normal lessons because of the self-regulation.

One student did not agree on the positive training effect, the student didn't really feel a learning effect, because nobody corrected [their] technique and there are no suggestions for improvement / correction of errors when throwing the basket. Some felt a bit distracted by the fun factor admitting that they paid less attention to the correct technique, but more to the fun factor and the achievement of points.

One student sums it up by uttering that the app can usefully extend the training, not replace it, which might serve as a summary assessment of this sport science pilot.

Conclusions

This analysis of case studies at a major German research university shows, that the technology of AR does not necessarily have to be limited to applications in the sciences, in medicine or engineering. It perfectly fits the needs of the humanities as well, that are usually not in the focus of the AR technology. The four cases in archaeology, media science, teacher training, and sport science that were introduced in this contribution prove that AR can be helpful as part of a concrete teaching concept. Here, the concept had to be about the use of AR in a peer learning setting (the iPEAR approach), following the assumption that applying visual means (like AR) in peer learning supports the

learning success of students. The FAU cases show that the impressions of students were always a bit mixed which might be connected to the different learning types that students represent anyway, and with the fortune of educators to embed the iPEAR intervention into their course.
Additionally, the cases show that the most different AR activities were applied like preparing a treasure hunt for the students (Archaeology), let students do the augmentation as part of students projects (Media Science, Teacher Training), or the use of ready-made AR (Sport Science).
As a rule, the activities applied in the FAU pilots were rather small. Christian Archaeology worked with Sketchfab 3D objects and a QR avatar; students of media science augmented the picture of an old TV and integrated it conceptionally into the media theory that they introduced to in their e-learning module; sport students worked with an AR training app during one session; teacher students brainstormed and experimented on AR in a two weeks unit on AR.
All educators involved in the FAU pilots expressed their interest to follow the iPEAR approach in their future teaching.

The iPEARMOOC

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Abstract

The short paper aims to briefly reflect on the iPEARMOOC (Multiple Open Online Course), which presents the research and findings of the iPEARproject and provides an incentive for educators to try the iPEARapproach, combining peer learning with Augmented Reality (AR), in a safe environment.

Keywords: iPEAR (Inclusive Peer-To-Peer Learning with Augmented Reality), Augmented Reality (AR), MOOC (Massive Open Online Course).

Introduction

In September of 2020, the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) joined forces with NTNU (Norway), AETMALab (Greece), Akto (Greece), and Eucen (Spain) to secure funding for the "Inclusive Peer Learning with Augmented Reality (iPEAR)" project through the Erasmus+ program of the European Union. Commencing in September 2020, the project is scheduled to conclude by the end of August 2023. These Erasmus+ projects, falling under the cooperative partnership framework, strive to foster collaboration with European counterparts, incorporating elements such as sustainability, inclusion, digitalization, and innovation within higher education. While not purely research-oriented, these projects adopt a pragmatic approach to ensure their outcomes have enduring effects.

Within its initiatives, the project has designed a MOOC to disseminate the iPEAR methodology. This MOOC serves a dual purpose: inspire interest in the utilization of Augmented Reality (AR) and peer learning in higher education, and offering a secure environment for initial AR experimentation.

Background of the iPEARMOOC

As previously mentioned, the iPEARMOOC plays a central role in the dissemination of the iPEAR project, which researched the combination of AR and peer-learning in higher education.

In their meta-analysis of 46 empirical studies, Garzón et al. (2019) highlight the growing popularity of Augmented Reality driven by its favourable impact on education and learning outcomes. According to Kaur et al. (2019), Augmented Reality has the potential to achieve the objective of visualizing interactive course content, thereby amplifying student motivation.

In the field of peer-learning, Crouch and Mazur (2018) provided supporting evidence indicating that peer-to-peer instruction improves students' grasp of scientific concepts, while Crouch et al. (2001) noted that it leads to heightened course satisfaction and better comprehension. Furthermore, Sakulwichitsintu et al. (2018) introduced a framework for leveraging peer learning to enrich the online learning experiences of students.

However, when the iPEAR-project started in 2020 there was hardly any literature on the use of Augmented Reality in combination with peer-learning.

Thus, after almost two years of conducting case studies at the partner universities of the project, the iPEAR-approach was summarized in a toolkit, a strategy and a teaching compendium, with all documents published under the creative commons licence and available through the iPEAR-homepage.

The creation of the iPEARMOOC aimed to provide students and educators with an opportunity to explore the iPEAR approach within a guided and secure environment, stimulating the generation of ideas for its integration into their own teaching and learning methods.

Given that neither FAU nor its partner universities possessed the necessary platform for the planned MOOC, a research initiative was undertaken to identify the most suitable provider. Following careful consideration, iMooX, an Austrian platform endorsed by the Austrian Federal Ministry of Education, Science, and Research in January 2020 (originally developed in collaboration with TU Graz and the University of Vienna), was selected. In 2021, iMooX was embraced by the European MOOC Consortium (EMC), the premier European MOOC platform, and has since grown to encompass 120 university-level online courses, enrolling around 86,649 students as of January 2023. Unlike its American counterparts, all content on iMooX is not only freely accessible but also reusable under Creative Commons licenses, facilitating its use for teaching purposes without charge.

Drawing from research on MOOC engagement and the authors' own experiences in various MOOCs, the objective was to design a MOOC that balanced high academic standards with practical application. To counteract the "loneliness of the long-distance learner" (Middleton, 2012) and the tendency of participants to disengage after a few weeks, the iPEARMOOC was thoughtfully designed to be time-efficient for full-time educators, while ensuring continuous support from the course team.

Consequently, the iPEARMOOC was established based on the following criteria:

- The course runs for four weeks, comprising four units, with active support from the course team during this period. Participants, however, have the flexibility to complete the course within three months without course team involvement.
- The anticipated workload is approximately two hours per week.
- The MOOC encompasses diverse multimedia elements, including text, images, videos, and downloadable documents.
- Two synchronous virtual sessions will be conducted via ZOOM.
- Rigorous monitoring of forums will be maintained, with a maximum 24-hour response time.
- The MOOC incorporates several quizzes, a midterm assessment, and a final evaluation.
- A culminating assignment involving a minor AR project is requisite for earning the course certificate.

The MOOC will undergo two cycles, with the second iteration benefiting from insights gleaned from the first.

The initial iPEARMOOC launched in October 2022 and remained open until January 2023. However, active course team support was provided solely during the first four weeks. Subsequently, participants retained the option to conclude or initiate the course without ongoing assistance.

The second iPEARMOOC started in April 2023 and again was supported actively until July 2023. The iPEAR-project finishes at the end of August 2023. However, the MOOC will continue to run as a self-study course and thus be available online for another three years.

The iPEARMOOC Content

As highlighted in the preceding section, the iPEARMOOC lasted a total of four weeks, with each week corresponding to a distinct Unit. These Units encompassed the key outcomes of the iPEAR research project: the iPEAR approach, an augmented reality (AR) toolkit for peer learning, and the iPEAR pedagogy designed to amplify student motivation and engagement.

Within each Unit, participants were furnished with comprehensive task summaries available both as readable text and as downloadable documents. The content for each Unit was presented through a combination of project-authored videos, external video resources, and textual documents. Furthermore, optional reading lists were assembled for the initial three Units.

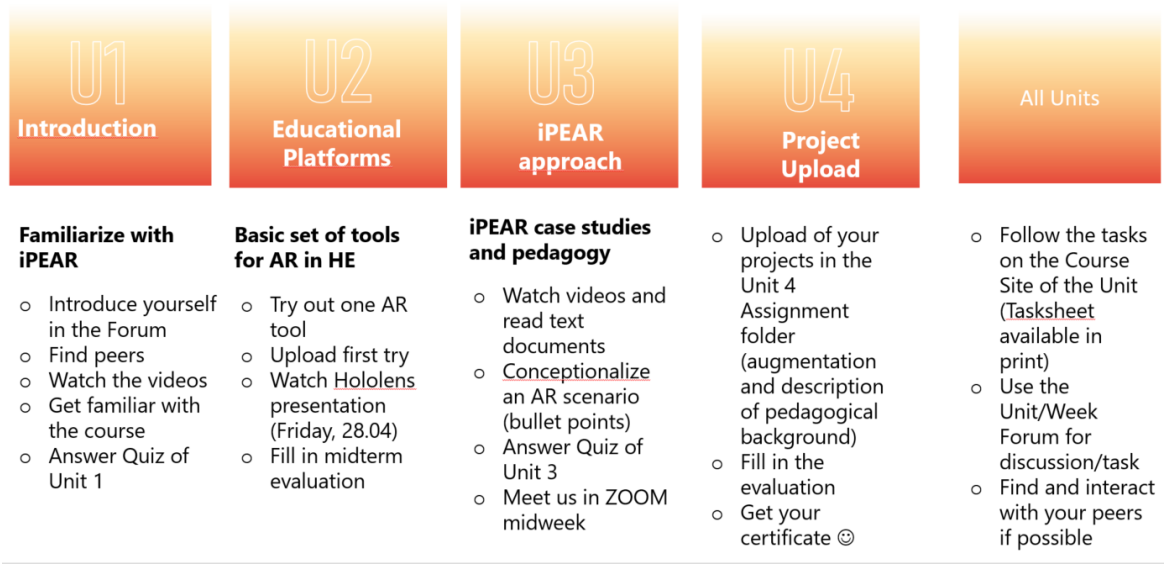


Figure 1: The Units of the iPEAR-MOOC

Unit 1: Introduction to iPEAR

This Unit acquainted students with the iPEARMOOC's structure and the overarching goals of the iPEAR project, which blends peer learning in higher education with augmented reality. Participants received an orientation on utilizing the iPEARMOOC and were apprised of their responsibilities. Weekly task sheets were distributed, and successful completion was rewarded with a pre-designed badge by the course team. Tasks evolved progressively from Unit 1 to Unit 4, aligned with the systematic introduction of AR in peer learning. To fulfil the iPEARMOOC requirements, participants were tasked with creating a concise iPEAR project proposing an AR activity for peer learning, complete with a pedagogical concept. The project's feasibility within the iPEARMOOC's workload parameters (2 hours per week) was emphasized.

Participants were encouraged to introduce themselves on the forum and connect with peers via an iPEAR padlet. Data protection norms were considered, and participants were duly informed. Approximately 100 participants engaged in forum discussions, while another 85 employed the padlet to foster connections.

Four videos produced by FAU project members provided an overview of the Unit's content, explaining the iPEAR project and its utilization of AR and peer learning in higher education. A live Zoom session capped off the week, offering an opportunity for interaction and Q&A.

A comprehensive video playlist, accessible on YouTube (Video-Playlist iPEAR-MOOC, 2023) displayed the iPEARMOOC's videos, including a trailer, weekly content videos, and the recorded Zoom session.

Unit 2: Tools for AR Educational Experiences

This Unit delved into AR tools suitable for educational contexts, particularly focusing on WebAR and mobile AR applications. The iPEAR toolkit, encompassing the detailed descriptions of tools, was available for download from the iPEAR website. Participants were introduced to ARTutor and Scavenger, both offering documents in English and Greek. Collaboration with peers from Unit 1 facilitated exploration.

Unit 3: iPEAR Case Studies

Unit 3 spotlighted iPEAR case studies undertaken at partner universities, demonstrating the iPEAR approach's practical application across diverse disciplines. A video presented these case studies, accompanied by in-depth documents for deeper understanding. Participants were tasked with conceptualizing an AR scenario based on the iPEAR pedagogy, fostering discussion among peers.

Unit 4: iPEAR Project Presentation

In the final week, participants integrated their pedagogical concepts from Unit 3 with a brief AR activity to craft their own iPEAR projects. The choice of AR tools was flexible, including those covered in Unit 2 or from the iPEAR toolkit. Detailed pedagogical concepts and final augmentations were uploaded, culminating in their individual iPEAR projects.

Forums: Fostering Community

To mitigate the potential isolation of online learning, forums were instrumental in building an active community. Participants were encouraged to introduce themselves in Unit 1's forum, receiving personalized responses from the course team. This effort aimed to foster trust and sustained engagement, adhering to Salmon's principles for active communication within the cohort.

In essence, the MOOC journey was structured across these Units to progressively acquaint participants with the iPEAR approach, AR tools, case studies, and practical application through iPEAR projects. The engagement-promoting elements, such as forums and interactive sessions, contributed to a collaborative and enriched learning experience.

Evaluation of the MOOC

Two evaluations were conducted: a mid-term assessment and a final evaluation at the conclusion of week 4. Participant engagement remained anonymous, yet to qualify for the iPEARMOOC certificate, both evaluations required completion, along with other designated tasks. The subsequent discussion focuses on the most notable findings.

Mid-term Evaluation

The mid-term evaluation, carried out after two weeks, aimed to determine if participants effectively engaged with the MOOC. Emphasis was placed on gauging their familiarity with the iPEARMOOC structure, successful peer interactions, and perceived adequacy of course team support.

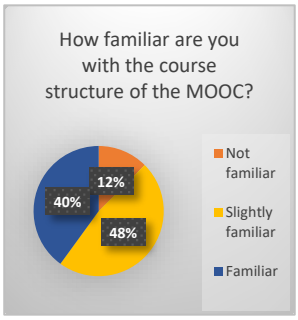
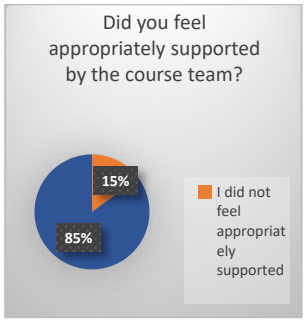


Figure: 1



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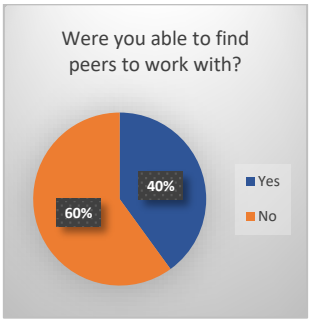


Figure: 3

Regarding familiarity with the course structure, while only 12% of participants felt unfamiliar, a higher 40% deemed themselves familiar (Figure 1). This indicates the need for improvement in clarifying the course structure. An introductory visual overview may enhance participant comprehension.

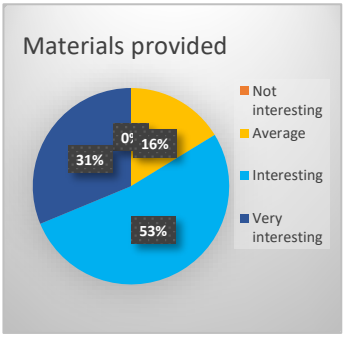
Course team support garnered a commendable 85% approval rate (Figure 2). The qualitative input was integrated into the second iPEARMOOC iteration to further enhance guidance, building on the effective efforts of task clarification, communication, and timely responses demonstrated in the first run. Enhanced forum interaction was planned for Week 3, where engagement declined initially decline. To serve this purpose, an additional ZOOM-Conference was offered in form of a Question and Answer Session.

Participants were encouraged to connect with peers, utilizing a padlet and forum in Unit 1. Notably, 79 participants used the padlet, with others connecting naturally within student cohorts. However, only 40% were successful in finding peers for collaboration, a crucial aspect of the iPEAR approach (Figure 3). To improve peer-finding, alternative, participant-preferred platforms were explored. However, due to the ease of using the posting function within Padlet, it was used in the second run of the iPEARMOOC again.

Material engagement was gauged, revealing room for improvement, with only 31% of participants finding the material very interesting (Figure 4). Enhancing material engagement can potentially lead to a smoother course progression.

Participant responses on task and unit timing indicated satisfaction, with 40% deeming it very good and 29% good (Figure 5). Nevertheless, 48% reported insufficient time to follow the course (Figure 6), which will require further investigation.

Figure: 4



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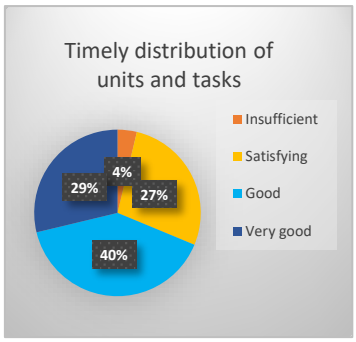

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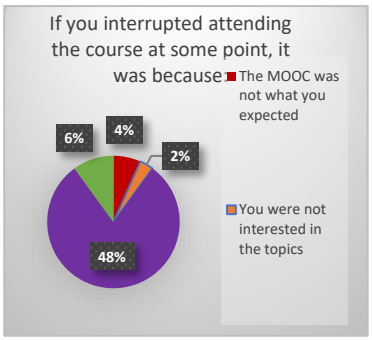
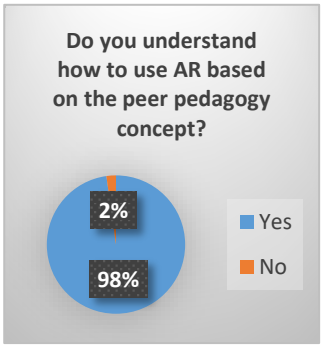


Final Evaluation

In the final evaluation, the participants´ understanding of Augmented Reality within the peer pedagogy framework was assessed, yielding an impressive 98% satisfaction (Figure 7).

Figure: 7



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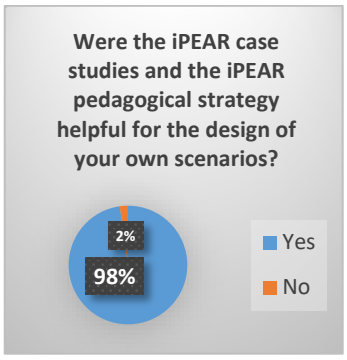

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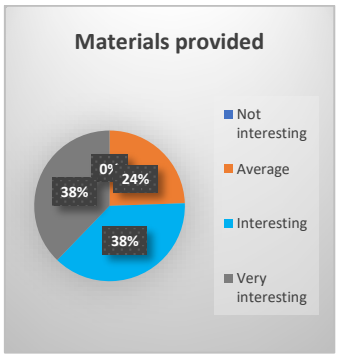

Similar positive results were seen in terms of design usefulness, with another 98% expressing contentment (Figure 8). This demonstrates the effectiveness of instructions and tools provided, aligning well with the intended 2-hour weekly workload.
It is noteworthy that participants showed greater interest in the provided material during the latter part of the course. Specifically, 38% found it interesting, while an additional 38% considered it very interesting (Figure 9). This pattern could suggest that the explanation of the pedagogical approach in the third and fourth weeks contributed to heightened interest. Alternatively, one might interpret these findings as indicating that by the course's conclusion, participants had accessed and likely gone through all the material in order to complete their final assignment, giving them a comprehensive overview of the content available.

Timely task distribution exhibited improvement in the final evaluation, potentially reflecting an improved grasp of the iPEAR approach's tools and pedagogy.

Qualitative Feedback

Qualitative feedback was divided into positive and constructive comments. Positive sentiments encompassed participants' appreciation for the subject's appeal, its informative nature, and innovative peer learning concepts. The accessibility of AR tools and the provided material was also lauded (Figure 10).

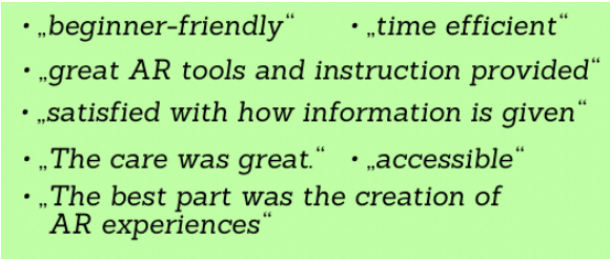

Figure 10

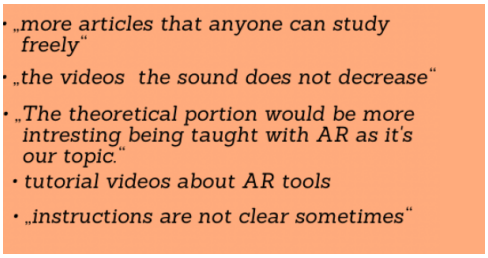

Figure 11

Constructive feedback highlighted areas for enhancement, including accessibility, organization and structure, peer learning, material, and AR tools. Participants requested more inclusive seminars and multilingual options. Further interactivity, additional synchronous meetings with tutors, and an integrated chat system were suggested for enhanced peer connection (Figure 11).

In summary, evaluations illuminated successes and areas for growth in the MOOC. The positive outcome of participant understanding and engagement demonstrates the efficacy of the approach, though refinement in various aspects promises an improved second MOOC iteration.

Conclusion

According to Jordan (2015), the completion rate for MOOCs is typically below 10%. Evaluation of the MOOC revealed both successes and areas for improvement. The mid-term and final evaluations indicated high participant satisfaction with understanding AR concepts and the course design. However, participant engagement in forums exhibited fluctuations, and some participants found the course workload challenging to manage within the specified timeframe.

Despite a relatively low completion rate, (52 out of 575 participants successfully submitted final assignments), the completion rate was considered satisfactory given the complexity of the tasks involved, including creating an AR project alongside a pedagogical description. The MOOC was successful in disseminating the iPEAR approach and fostering engagement among a diverse group of participants.

Based on participant feedback and the lessons learned from the first iteration, the second MOOC was refined and executed successfully in April 2023.

Conclusion

In conclusion, the iPEAR project and its associated MOOC demonstrated the potential of integrating augmented reality and peer learning in higher education. The project's innovative approach and its efforts to disseminate knowledge and engage participants through the MOOC contributed to its overall success, even with a modest completion rate. The project's outcomes suggest that well-designed MOOCs can effectively support the adoption of new teaching and learning methodologies in the digital age.

References

Garzón, J., Pavón, J., & Baldiris, S. (2019). Systematic review and meta-analysis of augmented reality in educational settings. Virtual Reality, 23(4), 447-459. https://doi.org/10.1007/s10055-019-00379-9

Jordan, K. (2015). Massive Open Online Course Completion Rates Revisited: Assessment, Length And Attrition. ResearchGate. https://doi.org/10.13140/RG.2.1.2119.6963

Kaur, D. P., Mantri, A., & Horan, B. (2020). Enhancing student motivation with use of augmented reality for interactive learning in engineering education. Procedia Computer Science, 172, 881-885. https://doi.org/10.1016/j.procs.2020.05.127

Middleton, D. (2012). The loneliness of the Long-Distance student: supervising students you rarely see. In Palgrave Macmillan UK eBooks (S. 226–235). https://doi.org/10.1057/9781137003560_17

Sakulwichitsintu S et al. (2018). A peer learning framework for enhancing Students' learning experiences in online environments. In: 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT). IEEE.

Video-Playlist iPEAR-MOOC. (2022, 10.31). [Video playlist]. YouTube. https://www.youtube.com/playlist?list=PLhy2nHJciTEA-vvFyh80Re6dNCRJ4CShO

“pARty in Europe” - An educational board game enhanced with Augmented Reality

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Abstract

This paper presents the design and implementation of an educational board game enhanced with Augmented Reality (AR) features. The game was built by a group of students and teachers at Eleftheroupolis’ High School in Greece. The main goal was to create an entertaining game which combines the characteristics of a classic board game with modern technology. As a result a trivia board game with six categories of questions was created called “pARty in Europe”. The innovation of the game is its interactive board which depicts a large map of Europe allowing players to trigger AR questions. The implementation phase of the game provided students with opportunities to collaborate with peers, visualize the products of their collaborations and to create their own content. A preliminary evaluation with groups of High School students showed that “pARty in Europe” can provide opportunities for active learning and attract positive user experience.

Keywords: Augmented Reality, Board Games, Geography

Introduction

AR technology has evolved and nowadays there is a plethora of online platforms that can be used in creating AR experiences. These platforms have distinct characteristics and features and can be used by educators and students since they provide a simple user interface and lots of tutorials and examples. AR experiences can be viewed through mobile devices like phones and tablets. There are more expensive solutions like Head Mounted Displays (HMDs) such as Microsoft Hololens and transparent displays (Terzopoulos et al., 2023).

AR has significant potential to transform education by providing immersive and interactive learning experiences for students. AR can help visualizing in 3D, complex concepts that are difficult to grasp. Furthermore, AR can provide virtual field trips by allowing students to explore historical sites, natural wonders, or cultural landmarks from the comfort of the classroom and without leaving the school premises. Complex simulations and experiments can also be demonstrated through AR allowing students to experiment in a safe and controlled virtual environment. AR can also transform printed books by providing dynamically additional virtual information that can be selected by the

educator. Collaborative learning is also supported in AR, allowing students to interact and work together in shared virtual environments. As an innovative technology, AR has the potential to enhance educational board games by introducing new interactive digital elements to the physical gameplay experience, exciting players.

Related Work

There are several attempts to use AR technology in board games. In the study of Nordin, Nordin and Omar (2021) a monopoly-based game with AR intervention is proposed, attempting to utilize gamification into the education context and to exert the element of fun in learning. A board game enhanced with AR for health education is presented in the study of Lin et al., 2020. Evaluation results indicate that AR technology enhances the motivation in learning.

Over the last years a considerable number of educational applications have been developed which make use of AR technology in maps or Geography in general. Among them, GeoAR (Chitaniuc and Iftene, 2018) was created with the aim to learn more about the Geography of Europe in a more attractive and interesting way. The target group of the application is secondary education students and its purpose is to use printed maps and AR in order to explore flags, capitals and neighbors of European countries. It also contains a quiz module to test students' acquired knowledge. The evaluation of GeoAR showed that both teachers and students agreed that the lessons can be more attractive with AR application and it can help teachers better present the new content of the lessons.

Description of "pARty in Europe"

The board game "pARty in Europe" is an exciting journey of knowledge, a walk-through countries and cultures taking as a ticket … correct answers. It is a party board game that attempts to combine the traditional with the modern, classic party games with AR technology. Players move the dice on the board and answer questions, with the goal of winning a card and placing it in their passport. The cards contain questions about different European countries and are divided into categories according to the type of questions. The categories are History, Geography, Culture, Sports, General Knowledge and AR. The contents of the board game are illustrated in Figure 1.

Figure 1. The contents of the board game

More specifically: Each player gets a pawn and a passport. The players then place their pawns at the starting station and the player with the highest number on the die starts first. The player who plays rolls the die and moves his pawn to the corresponding positions on the board. He has to answer a question of the corresponding category that indicates where he is, or follow the command given to him. The previous player draws the first card from the question pile of the appropriate category and reads the question. If the respondent answers correctly, he "stamps" his passport, i.e. takes the corresponding card and places it in his passport. In case the player succeeds in an AR question, he opens the AR application, observes the map for 10 seconds and answers the corresponding question. The AR application enriches the map with information, pictures and 3D models on the selected area (Figure 2). The winner is the first player who answers ten questions correctly. But there is one limitation. The winner must have placed in his passport five cards of different countries - regardless of the category of the question - and five AR cards.

Figure 2. Screenshot of the triggered AR experience

Technical Background

The augmented reality application of the game was built using ARTutor (Terzopoulos, Kazanidis and Tsinakos, 2022). ARTutor is a free platform suitable for creating educational AR experiences. ARTutor uses an online web environment for the creation of the AR experience and a mobile application for viewing the AR experience. ARTutor is available for both Android and iOS devices.The ARTutor platform was selected for various reasons. It is completely free and easy to use. ARtutor supports all types of AR recognition:

- Marker-based AR, where reference images are recognized by the mobile device and digital content is displayed over them.
- Markerless AR, where horizontal and vertical surfaces are detected and virtual objects are placed on them,
- Location-based AR, where virtual content is displayed in the real world based on users' location.

For the board game the Marker-based AR feature of ARTutor was used. Reference images are recognized by the ARTutor mobile application using the device camera and digital content (images, videos and 3D objects) are displayed on top of the reference images. An interesting feature of ARTutor is that users can interact with the digital content by zooming in or out and rotating.

It is worth mentioning that the pawns were created by the students using a 3D printer. All phases of the game design and implementation required students to work together and make use of various software like text editors, image processing applications, video editors, 3D modeling software, image repositories as well as encyclopedias to create the questions.

Learning Goals

The digital literacy of students is now considered necessary and is seen as a challenge in the school space, as new technologies, digital media and tools, are increasingly integrated into the educational process. Learning in the modern world acquires new content, as the traditional approach to knowledge does not appeal to young students. Therefore, we are invited to try new techniques and new ways - more compatible with the world of children - in order to strengthen the desire for knowledge, attract student interest and achieve the expected learning results.

Through the process of designing and implementing a board game using AR technology, students are expected to cultivate social, cognitive, technical skills. Participating students are expected to:

- Get to know in an alternative, fun way for them, the history, geography and culture of Europe, discover through space and time, as they will look for information about the countries that make up the European puzzle, check and cross-reference information, formulate questions.
- Develop digital skills through the application of AR technology, a "bridge" between tangible and digital world. Our students, moreover, live in a world that requires the use of increasingly modern technologies, and education cannot remain unaffected.
- Undertake tasks and carry out a project consisting of several stages, understanding in practice concepts such as planning, production and evaluation.
- Become familiar with the use of modern technology tools such as AR applications, the 3D printer and to utilize existing knowledge and produce new ones.

The implementation of such a project has also the goals to:

- promote students' acquisition of skills of reflective people, who research, generate original ideas, become creative and effective.

- the cultivation of critical, synthetic and analytical thinking enhancing students' self-esteem, empathy and adaptability, virtues that enable them to connect and communicate with others.
- the strengthening of teamwork and the cultivation of a climate of cooperation between students and teachers as well as between students through collaborative problem solving.

The learning objectives set from the beginning were served to a large extent. Students were actively involved in the entire process of designing and producing the game. They took initiatives, made decisions through democratic processes, organized their thinking and actions, became creative and produced original ideas. With the help of their teachers, they decided the type, the topic and the goal of the game, the categories of questions, they collected questions and answers, designed and created in the IT laboratory the cards, the board, the passports and also the pawns (using a 3D printer). They got excited, they used social media, they communicated. Essentially, the most basic of the goals, their active and enthusiastic involvement, was achieved.

User Experience Goals

The board game created is easy, fast, fun and educational at the same time. It tries to combine the traditional with the modern, classic party games with augmented reality technology, so that players can enjoy the journey of knowledge while reaping the benefits of participating in a game of this kind: a sense of autonomy but also teamwork, discipline and respecting the rules, boosting confidence and respecting the opposing player, strengthening bonds and strengthening relationships. But in addition to the socio-emotional skills offered by the natural social interaction around the board of a board game, players cultivate cognitive skills, as they "learn" by playing, their observational skills are strengthened, their ability to concentrate, connect events and recall information. The use of mobile devices is not a digital distraction but an attractive way to reveal the world that is "hidden" on the game board.

Pilot Study

The last part of the development phase of “pARty in Europe” was its evaluation by groups of students. From each class of Eleftheroupolis’ High School 4 students volunteered to participate in the evaluation phase, and agreed to play at least 3 rounds of the board game. Since there are 15 classes, a total of 60 students played the game (7th, 8th and 9th grade). The whole process was monitored and organized by all members (students and teachers) of the development team. The students gave instructions to participants and helped them to understand the rules of the game, intervening whenever necessary. The teachers monitored the process, observed the game play and took notes of students' reactions and behavior.

The evaluation phase showed that the game was overall very entertaining and easy to play. Most of the groups expressed the desire to play one or two more rounds of the

game. All players were able to learn the rules of the game very quickly and enjoyed playing the game. Some questions appeared difficult to them, but at the same time they recalled them from school subjects. Although they were familiar with similar board games, they found very innovating and interesting the augmented reality feature. Augmented reality allowed players to interact with the European map and visualize the location of famous landmarks, flags of countries and names of places. Using the ARTutor application, players were asked to memorize objects and concepts and relate them to specific countries.

Conclusion

This paper presented the design and implementation of “pARty in Europe”, an innovative, interactive board game created by a group of students and teachers. The game uses ARTutor for providing AR experiences during the game. The board game was developed mostly by students with the assistance of the educator. Students that played the game enjoyed the game. AR technology can enhance boarding games and excite players. However, the success of AR integration in board games depends on the execution and how well virtual elements blend with the physical gameplay experience. In our case, the feedback was positive.

References

Chitaniuc, M., & Iftene, A. (2018) ‘GeoAR-An Augmented Reality Application to Learn Geography’, *Romanian Journal of Human-Computer Interaction*, *11*(2).

Nordin, N., Nordin, N. R. M., and Omar, W. (2021) ‘Monopoly-based Game with Augmented Reality Intervention in Higher Education’. In *Knowledge Management International Conference (KMICe 2021)*.

Lin, H. C. K., Lin, Y. H., Wang, T. H., Su, L. K., and Huang, Y. M. (2020) ‘Effects of incorporating ar into a board game on learning outcomes and emotions in health education’. *Electronics, 9(11)*, 1752.

Terzopoulos, G., Kazanidis, I., Tsinakos, A. (2022) ‘Building a General Purpose Educational Augmented Reality Application: The Case of ARTutor’. In: Auer, M.E., Tsiatsos, T. (eds) *New Realities, Mobile Systems and Applications*. IMCL 2021. Lecture Notes in Networks and Systems, vol 411. Springer, Cham. https://doi.org/10.1007/978-3-030-96296-8_16

Terzopoulos, G., Kazanidis I., Tsinakos, A., Karabatzakis, D., Georgiou, D. (2023) ‘Using Transparent Displays For Implementing Augmented Reality In The Classroom’. Proceedings of the *15th International Conference Economies of the Balkan and Eastern European Countries (Under publication).*

Teaching Ancient Greek in a Secondary School with the support of AR tools: A pedagogical concept

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Abstract

In a world that constantly changes and in which technology plays an important role, it is crucial to focus on the education provided to the next generation. When it comes to teaching classical studies and especially the discipline of Ancient Greek, the pedagogical strategies, methods but also the value of the subject, are often called into question by the students. Frequently they doubt the usefulness of studying Ancient Greek. It is often considered as one of the most difficult subjects in Greek Secondary Schools. It is of great significance for teachers to incorporate new methods and approaches in their teaching in order to trigger and maintain their students' interest and attendance. Technology and AR tools can contribute in this aspect and stimulate the imagination. The aim of this paper is to provide a pedagogical concept and lesson plan for teachers interested in integrating New Technologies in their teaching. With specific AR tools in combination with peer-to-peer learning, students may be motivated to work on the ancient Greek cultural heritage, here represented by the epic poem of Odyssey by Homer. This approach supports active, experiential and inquiry-based learning as students learn by *doing* and experiment with the AR tools which are provided for educational purposes. Thus, AR tools used in education may provide a link between the present and the past, to revive visually and aurally an ancient Greek epic poem, like Odyssey, in the 21st century.

Keywords: Augmented Reality, teaching Ancient Greek, collaborative learning, inquiry-based learning

Introduction

Education is a basic human rightand works as a *"stepping stone to other fundamental human rights"*, as recognized in the Universal Declaration of Human Rights by UNESCO[5]. One of the requirements for quality education is equal participation of all students in the learning process. New technologies that entered with the 21st century have created more

[5] Cited official website of UNESCO,*https://www.unesco.org/en/right-education*

opportunities to fulfill this requirement. One of these New Technologies is Augmented Reality (AR), which will be discussed further on.

Teaching classical subjects in the present day can be seen as a challenge, as their usefulness is often doubted by many. Especially when it comes to the discipline of Ancient Greek, its value is often called into question by the students themselves.
In Greek Secondary Schools the subject of Ancient Greek Language and Literature is taught from the first grade and consists of two different components: the Ancient Greek Language and the Ancient Greek Literature. This paper focuses on the latter, namely the Homeric epic poems of Odyssey. The excerpts of Odyssey in the students' schoolbook are translated from Ancient Greek to the modern demotic Greek language in order to be more compatible with the age of the students and the objectives of the subject. It is their first contact with Ancient Greek[6].
In general, Ancient Greek Language and Literature is considered as one of the most difficult subjects in Greek Secondary schools. Students often show a lack of interestand participation in the lesson, especially when teachers don't adopt a student-centered approach and stick only to traditional methods. According to research from 2015 (DespoinaSakelli, FragkiskosBersimis)[7] that was conducted in multiple greek secondary schools, nationwide: about 30% of the students don't find the subject useful,about 65% of the teachers believe that the textbook isn't attractive for the student, andabout 80% of them believe that the visual material is limited in it,while about 56% of the students would like more visual material.

The incorporation and usage of New Technologies in the teaching process of this subject may have positive results. More specifically the technology of Augmented Reality (AR) may trigger and maintain students' interest and attendance. The visual representations provided by AR can stimulate the imagination of the students. With specific AR tools, such as the ARTutor app which is designed by AETMA LAB and suggested by the iPEAR approach, students may be initiated to work together in pairs or in groups, thus supporting collaborative learning and peer to peer learning. The following lesson plan supports active, experiential and inquiry-based learning. The teacher of the classroom can help them with the resources and coordinate the learning activities that follow.

The pedagogical Concept

The identity of the concept

Title: Approaching the epic poem of Odyssey in Secondary School: a pedagogical scenario for rhapsody 5

[6] Fountopoulou (2010)
[7] Despoina Sakelli, Fragkiskos Bersimis (2015)

The discipline: Ancient Greek Language and Literature – Homeric epic poems: Odyssey

Education grade and class: First grade of Secondary School – Gymnasium

Specific area in the discipline: Unit 8 (rhapsody e (book 5) verse 165-310/<149-281>), from the Greek Schoolbook "Ancient Greek Homeric epic poems Odyssey" (The extracts included in this book are translated from Ancient Greek to Modern Greek)

Compatibility with the Cross-thematic Curriculum Framework and the Analytical Curriculum: The following pedagogical concept - scenario is compatible with the Cross-thematic Curriculum Framework (CTCF) and Analytical Curriculum considering that the research, the comprehension, understanding and interpretation of the human behavior, as it is represented in the Homeric epic poem are some of the basic aims for the subject of Ancient Greek. More specific the primary goal of the Cross-thematic Curriculum is the understanding, from the students' part of Odysseus dedication to his "nostos", meaning his return home, to Ithaca. Also, students may estimate the value of the struggle someone must endure to reach his goals. They will investigate Odyssey's construction and learn about the narrative techniques used by Homer. Moreover, they will evaluate the actions and behavior of the main characters of the story. This unit is suitable for incorporating modern teaching techniques and using new technologies to create new learning environments.

Learning Objectives: The general aim of this pedagogical concept is that students can experience Odysseus encounter with the nymph Calypso on the island Ogygia, which is a critical point for the plot of the poem, with the support of New Technologies. Also, part of the aim is to train students on rendering the meaning of the poem and understanding the language choices and narrative techniques Homer uses.
Furthermore, goals are that students should be able to: interpret the extract from the epic poem but also to analyze the connection with previous rhapsodies, to detect with a text-centered approach, the narrative techniques that Homer uses, to train on outlining the characters of Odysseus and Calypso and to use tools provided by New Technologies to foster computer literacy.

Proposed teaching method: For this concept a combination of teaching methods is chosen. The basic method and approach chosen is the text-centered and interpretive. The same teaching approach is usually chosen for the subject of Literature and is a point of convergence for these two subjects[8]. It is based on the search of the thematic centers of the text, the comprehension of the content in an experiential way and not only focusing on the structure of the language in the poem. The text- excerpt is placed in a context, taking into consideration historic and social axes. The subject of Ancient Greek Language and Literature, in the first grade of Secondary School in Greece, is remarkable because it's actually the first time students come into contact with the ancient form of Greek. Although it is the same language, there are differences. Many times, students find the subject quite difficult and that is why it is emphasized also in the Analytical

[8] Fountopoulou (2010)

Curriculum, to focus on interpretation and not study in-depth the grammar and syntax at this point[9].Simultaneously, the communicative approach is as well taken into consideration, which is based on the communicative framework. What interests the reader are the message, the content and the ideas which are emerged from the text. The interpretive method focuses on the interpretation of the text, which can be enriched with the student's previous knowledge or information from the introduction of the book. A primary goal is to develop the student's critical and linguistic literacy. For a deeper comprehension of the epic poem, first the teacher adopts a holistic approach to the text and afterwards works it through, analyzing the different parts and details.

Estimated timeline for the Lesson: The estimated time for the scenario is two school hours in a row (about 90 minutes). This is usually proposed by the Analytical Curriculum as well, when it comes to teaching this subject in the first grade of secondary school.

Material and tools: For this lesson the material needed is the schoolbookfor the subject *Ancient Greek Language and Literature – Homeric epic poems: Odyssey*, but also the same AR Book on ARTutor. For the AR activity the students must have their mobile devices, a smartphone or a tablet so that the sensors (cameras) of the devices can recognize the trigger images and objects. Taking into consideration that some students may not have a mobile device, it is important that the teacher and the school cooperate to provide the AR experience to every student. Due to the possibility of fewer devices available, students will pair up in groups and enhance their social skills, like cooperation and communication. Additionally, the teacher will need a laptop and a data projector to display a PowerPoint presentation with images and links included. Finally, students will receive a worksheet.

The concept – scenario

Learning Activities

The first activity is an introduction to the new unit. The teacher asks questions and students try to recall the ending of the previous unit. This helps to create a link with the new unit, so that students conceive the poem as an entirety. Examples of questions are: "What happened in the previous unit?" "Who came to visit Calypso in Ogygia and for what reason?". Afterwards, the teacher can show some images of artworks with the figures of Odysseus and Calypso and the students with the guidance of the teacher will describe them. They are called to make a hypothesis about what will happen in unit 8. Furthermore, the teacher may read the verses 165-251 from book 5 (unit 8 in the schoolbook), after giving the students some reading instructions like underlining the words that refer to Odysseus's and Calypso's feelings and the arguments, to prepare them for the dialogue between these main characters.

[9] Petsimeri (2004)

Afterwards the students will be encouraged to interpret the arguments and crescendo in them from the dialogue between Odysseus and Calypso. They will work thoroughly on the verses 165-251 to detect the narrative techniques by Homer, like the Homeric epithets, foreshadowing or Homeric similes. The teacher will support the students with questions to guide them.
Before the end of the first school hour, the teacher can use a website like Padlet[10] to share in the classroom the ideas of the students. They can give an adjective for each character to describe them as they appear in this rhapsody.
The first hour is spent more on the text- excerpt with a text-centered and interpretive approach, which is basic for the students for understanding the content of the new unit. For a deeper comprehension of the epic poem, first the teacher adopts a holistic approach to the text and afterwards works it through, focusing on the different parts and details.
The reason the AR activity starts from the beginning of the second hour only, is because AR comes to support the learning process and isn't the only objective. The pupils are eleven to twelve years old and probably it will be their first experience with AR technology. It is crucial for them to understand first what it is or what it means all the things and visual content they are going to see.

AR Activity

The second school hour is dedicated to the AR activity. Studentsare encouraged to pair up in small groups to use their mobile devices. Per group one device must be available. The teacher will give the proper instructions as to how to download the app of the AR tool. The suggested AR tool for usage is the ARTutor, which is free to use for educational and academic purposes, designed by AETMA LAB as mentioned above. The idea is that with the printed version of the book the students will scan the pages of the book with their device and when the sensor will detect a trigger image the corresponding augmentation will be displayed[11] (Lytridis& Tsinakos, 2018, p.5).
If there isn't a printed version of the book available, ARTutor can work on the electronic version of the book as well (e.g. via the teacher's laptop or a second mobile device in each group, if available).
The first augmentation the students will view when scanning the verse 165 in the book, is an image of god Hermes to link the new unit with the previous. Hermes in unit 7 went to Ogygia to inform Calypso of Zeus's will: the nymph must free Odysseus and let him go back to Ithaca to fulfill his destiny.
As they go through the text again, they will see the second augmentation on the verse 171. They can be images of famous artworks, e.g. Arnold Böcklin's painting "Odysseus und Kalypso, 1883", or William Russell Flint's painting *"Homer's Odyssey, No.6, 1914-1924"*. The third augmentation is a 3D object of Odysseus. Students can observe his figure and look closely at his characteristics. This digital content may foster active learning and experiential learning as well as inquiry-based learning. The students

[10] The official website of Padlet is *https://padlet.com/*
[11] Lytridis& Tsinakos (2018)

experiment, search for the trigger images and learn by doing. They collaborate with their peer as they fill in the worksheet. One exercise on the worksheet can be linked with the AR activity. A student of the group searches for the augmentations while the other writes down what augmentations they foundand also tries to describe them in a few words.
The verse 190 may provide another augmentation: a map of Odysseus's journey, after the Trojan War. Thereby the students will have the opportunity to keep in mind the several stations in Odysseus' journey, his "nostos". It is important to remember what happened before in the epic poem to keep a chronological track as much as possible. The Odyssey is a complicated epic poem when it comes to untangle its timeline, especially for students in the first grade, as it is written in medias res. Thus, a map with clear bullets and info about the books may help.
One last image can be added to the verse 215, showing a painting of Odysseus' and Calypso's dinner together, e.g. Jan Brueghel's painting "La caverne fantastique avec Ulysse et Calypso (v. 1616)", or Joos de Momper "Le repasd'Ulysse avec la nymphe Calypso". This part in unit 8 is very crucial because the dialogue that follows between Odysseus and Calypso is critical for his departure. Calypso tries one last time to convince Odysseus to stay with her, with a crescendo of arguments in her speech. Odysseus thereupon answers and tries to appease her in order to go back to his home, Ithaca. The imagination of the students must get triggered in order to keep their interest at this part of the lesson.
The last AR augmentation might be a music video or an animated video from YouTube, about Odysseus and Calypso. Because the next generations may not know the greek cultural heritage especially when it comes to music, the teacher can add the song "Calypso", which is composed by the famous composer Mikis Theodorakis and sung by Maria Farantouri. The teacher can ask questions about the lyrics and content of the song. In this way the students can search for the similar points of the song with the poem. Small writing exercises in the worksheet will help them express their opinions to discuss them later in class.
After the AR activity the teacher can encourage the students to record their work as a group, i.e. the scanning and the display of the digital content. They can do so with a screen recorder app so it can be uploaded on the school website or on an educational platform like "E-class"[12].

Conclusion

This paper focused on providing a lesson plan for the teaching of Ancient Greek in Greek Secondary Schools with the support of New Technologies. More specifically it referred to the subject of Ancient Greek Language and Literature, Homeric epic poems Odyssey which is taught in the first grade. This lesson plan refers to Unit 8, rhapsody e, in the school textbook. It suggests using the Augmented Reality app ARTutor, to enhance the teaching material provided to the students. This allows students to interact and

[12] The website of E-class https://eclass.sch.gr/

experiment with digital content to acquire a new collaborative learning experience and to trigger their interest and imagination. Thus, students will have played a more active role in the learning process.
When it comes to education there is not a panacea for teaching. Teachers should try out different methods, techniques and teaching material for each lesson, taking always into consideration the students and their needs. The question remaining is: Can we revive something that was written 2700 years ago?Maybe the New Technologies for example Augmented Reality, built us the bridge to reach it.

References

E-class (2023). Available at: https://eclass.sch.gr/ (accessed: 25 May 2023)
Fountopoulou, M. (2010) The framework that defines the teaching of Ancient Greek from translation, From the theory to the classroom. Athens: Grigoris.
Lytridis, C. and Tsinakos, A. (2018) 'Evaluation of the ARTutor augmented reality educational platform in tertiary education', Smart Learning Environments, 5 (6), pp. 1-15. https://doi.org/10.1186/s40561-018-0058-x
Padlet (2023) Available at: https://padlet.com/ (accessed: 25 May 2023)
Petsimeri, E. (2004) Didactic Methodology, Didactic of Ancient Greek. Athens: Grigoris.
Sakelli, D. M. and Bersimis, F. G. (2015) 'Attitudes of students and teachers towards the course "Ancient Greek Language" of the first grade of Secondary school', MIBES Transactions, 9 (2), pp. 49-58
UNESCO (2023). Available at: https://www.unesco.org/en/right-education (accessed: 25 May 2023)

Building Educational Experiences to promote Peer Learning: The Utilization of Augmented Reality to a Transformative Learning Process through Aesthetic Experience

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Abstract

Peer Learning is an approach of education designed to promote active learning fostering collaboration and cooperation among learners. Transformative Learning is a theoretical approach of education based on the process of experience and critical thinking which promotes dialogue between instructor and learners, aiming at a more efficient learning process which helps trainees to reconsider their views and way of thinking. Furthermore, aesthetic experience as a means of developing imagination which contributes significantly to the learning process, has been used in a number of transformative learning approaches as a useful tool for the reinforcement of the transformative process. Augmented Reality (AR) is emerging as an effective tool that can be utilized in the learning process and is connected with high levels of achievement of learning goals. This study refers to the design of a transformative learning course through aesthetic experience including an AR experience which will promote the principles of peer learning. First impressions and conclusions related to the concept of the course, the contribution of the AR experience to peer learning, the effectiveness of the transformation process, as well as for the selected AR platform are recorded. Finally, suggestions for future pilot implementation as well as future exploitation are given.

Keywords: Peer Learning, Transformative Learning, Aesthetic Experience, Augmented Reality

Introduction

Peer Learning as an educational practice is designed to promote active learning among learners (Chun and Cennamo, 2022). Peer learning strategy enforces deeper understanding, learning motivation, and engagement by cooperating with peers and demonstrating promoting behaviours (Liu and Chen, 2020).

Augmented Reality (AR) is one of the emerging digital technologies that has aroused the most interest in the educational field, because it allows interaction between real and virtual space (Moreno-Guerrero et al., 2020). The combination of AR technology with the educational content creates new type of automated applications and acts to enhance the effectiveness and attractiveness of teaching and learning for students in real life scenarios.

Transformative Learning as a theoretical approach of education has been applied in different frames and fields of education leading to a more efficient learning process. Aesthetic experience is utilized in a number of transformative learning approaches as a means for the reinforcement of the transformative process (Cranton, 2006).

Regarding the use of AR technology and the integration of an AR experience in the classroom, the study depicts an attempt to integrate Augmented Reality in a transformative learning course through aesthetic experience in order to promote peer learning.

Literature Review

Peer Learning

Peer Learning is an educational practice which Topping (Topping, 2005, p. 631) defines as “the acquisition of knowledge and skill through active helping and supporting among status equals or matched companions…[which] involves people from similar social groupings who are not professional teachers helping each other to learn and learning themselves by so doing”. It is based on the sociocultural theory of the zone of proximal development and incorporates the foundational concepts of scaffolding. Peer learning strategy emphasizes active participation, collaboration, shared responsibility, and reflection, creating a learner-centered approach that promotes deeper understanding and engagement. The model consists of four steps: knowing each other, learning together, checking what you learned, and finalizing the peer learning (Chun and Cennamo, 2022).

Collaborative Learning environments encourages learners to work in groups or pairs, fostering collaboration and cooperation. This collaborative environment allows students to share their knowledge, perspectives, and ideas, which helps in constructing new knowledge collectively and finally become active participants (Bruffee, 1999). Benefits of collaborative learning are the promotion of social interaction and the development of interpersonal skills. Students learn to communicate effectively, listen to others' perspectives, and engage in constructive dialogue (Jaramillo, 1996). Through collaborative learning, students can enhance their teamwork and leadership abilities, as well as develop empathy and respect for diverse viewpoints (Dillenbourg, 2000).

Shared responsibility in Peer Learning emphasizes the active participation and accountability of learners in their own learning process and the learning of their peers.

When learners take shared responsibility, they become more accountable for their own learning. They become active seekers of knowledge, asking questions, seeking clarification, and engaging in self-directed learning (Palincsar and Brown, 1984). By actively participating in the learning process, learners become more independent, self-regulated, and able to monitor and evaluate their own progress (Zimmerman and Schunk, 2001).

Active engagement in the learning process allows learners to connect new information with their prior knowledge, making meaningful connections and facilitating retention (Chi et al.,1989). By actively participating in discussions, problem-solving, and hands-on experiences, learners can explore concepts in a more meaningful and contextualized way. Active engagement also plays a crucial role in the development of critical thinking skills (Halpern, 2014). Through active participation in discussions, learners are exposed to different perspectives, engage in collaborative sense-making, and develop effective communication skills (Mercer, 2000). Discussions provide a platform for learners to articulate their thoughts, ask questions, and engage in constructive debates. Active engagement in discussions also enhances metacognitive awareness, as learners reflect on their own thinking processes and refine their understanding.

Reflection and metacognition also play a crucial role in Peer Learning as they enable learners to become more aware of their learning processes, evaluate their understanding, and make informed decisions to enhance their learning. Reflection allows learners to make connections between their prior knowledge and new information, fostering deeper understanding and meaningful learning experiences (Boud et al., 1985). Metacognition, on the other hand, involves thinking about one's own thinking processes and understanding how to regulate and control one's learning (Flavell, 1979). Metacognitive learners are more likely to engage in effective learning strategies, such as setting goals, planning their learning, and evaluating their progress (Zimmerman and Schunk, 2001). Engaging in reflection and metacognition in Peer Learning enhances self-regulation skills, allowing learners to take control of their learning process and foster critical thinking skills. When learners actively reflect on their learning experiences, they engage in critical analysis, evaluation, and synthesis of information (Mezirow, 1990). Metacognitive thinking enables learners to question assumptions, consider alternative perspectives, and evaluate the reliability and validity of their own knowledge (Schraw and Moshman, 1995). These critical thinking skills are essential for deeper understanding, problem-solving, and decision-making.

Peer feedback is a valuable component of the learning process that promotes reflection, self-assessment, and improvement. It benefits learners by providing multiple perspectives, developing critical thinking skills, and fostering a supportive learning community. To ensure the effectiveness of peer feedback, it is important to establish clear guidelines and criteria for the feedback process (Sadler, 2010). Providing learners with specific criteria or rubrics helps them focus their feedback on relevant aspects of the work.

The role of the tutor in facilitating collaborative learning, is a key component. It is important to note that the facilitator's role in Peer Learning is not to dominate or control

the learning process but to create a supportive framework that empowers learners to take ownership of their learning (Mercer and Littleton, 2007). The tutor guides and facilitates meaningful interactions among peers to ensure that learning is productive and relevant (Panadero et al., 2017). This can involve structuring activities, providing prompts or questions, and encouraging active engagement in discussions, problem-solving, and collaborative tasks (Boud and Lee, 2005). Furthermore, the tutor provides scaffolding and support to help learners navigate the learning process effectively. This can involve offering guidance, clarifying concepts, and providing resources or materials that support learners' understanding and development. Additionally, tutors play a crucial role in guiding and modeling effective feedback practices, ensuring that learners provide constructive and actionable feedback to their peers.

Transformative Learning and Aesthetic Experience

The term "Transformative Learning" refers to a theoretical approach of education aiming at a more efficient learning process which helps trainees to reconsider their views and way of thinking. According to Mezirow (Mezirow, 2009, p.92), transformative learning is “the process by which we transform problematic frames of reference (mindsets, habits of mind, meaning perspectives) – sets of assumption and expectation – to make them more inclusive, discriminating, open, reflective and emotionally able to change”.

Experience (Dewey, 1938), critical thinking (Freire, 1970) which leads to critical awareness as well as dialogue between instructor and learner are the most important elements of the transformational process. The concept of experience “allows a holistic approach to education, in the sense that it is based on the interaction between the human being and the world” (Hohr, 2013, p.1) while critical thinking acts as “a tool for self-determination and civic engagement” (Giroux, 2010, p.716). Finally, the transformative learning process leads to the reformulation of the criteria for valuing and taking action and is called perspective transformation (Mezirow, 1978, p.100).

Aesthetic experience concerns processes related to seeing, perceiving, understanding, and appreciating a work of art, as well as the pleasure and satisfaction that accompany these processes (Dewey, 1934), (Vessel et al., 2013, p.2). The contact with artworks can facilitate thinking through the critical observation in a way that allows individuals to approach them in their own way and discover their own meaning (Kokkos, 2022), develop imagination and finally contributes significantly to the learning process (Dewey, 1934). As a result, aesthetic experience can be used to reinforce the transformative process (Cranton, 2006) and is utilized in a number of transformative learning approaches.

Paul Freire was the first who integrated artworks and especially sketches in transformative learning process (Freire, 1968) for the examination of a social or more personal issue. A number of approaches for the utilization of aesthetic experience within the framework of transformative learning has been developed which are generally based on three actions: (1) observation of selected artworks, (2) posing critical questions and

(3) conversation about the examined issue. In these approaches, artworks of high aesthetic value13 as well as works of mass culture (Tisdell and Thompson, 2005) are utilized. However, important theorists such as Dewey and Perkins believe that the utilization of high aesthetic value artworks is more efficient to the enforcement of critical thinking.

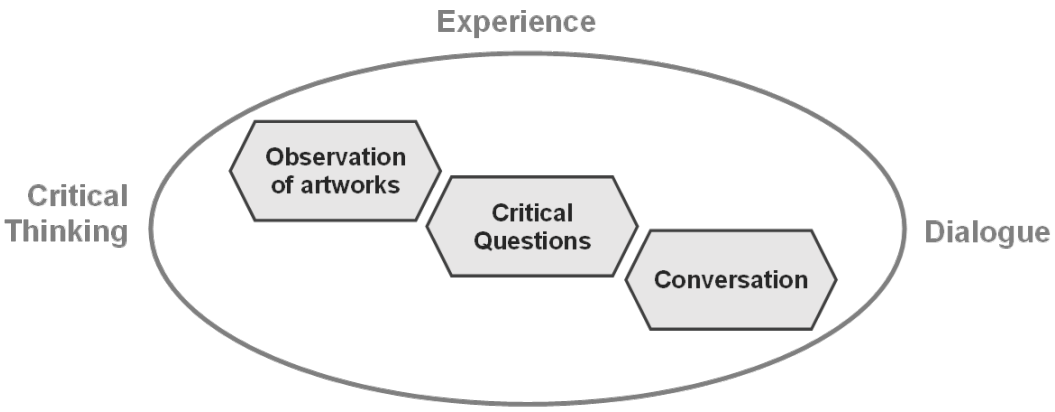


Figure 6. Key points of transformative learning methods that utilize aesthetic experience

Augmented Reality and Education

Augmented Reality (AR) is an emerging digital technology which allows the co-existing of physical and virtual objects (text, information, graphics (2D,3D)), sounds and other sensory stimuli and support real time interaction (Matcha and Rambli, 2013, p.1), (Moreno-Guerrero et al., 2020). AR was first defined as a medium that "combines the real and virtual, is interactive in real time and is registered in 3D" (Azuma, 1997, p.2).

AR is associated with high levels of achievement in learning goals (Akcayir and Akcayir, 2017) as it allows overlaying layers of virtual information on real scene with the aim of increasing the perception the user has of reality. (Diaz et al., 2015, p.206). Especially, AR has a significantly positive effect on motivation to learn due to elements such as curiosity, imagination, and the ability to engage in the process through interaction (Gopalan et al., 2017, p.2). In addition, AR shows significant benefit to support learning e.g., supporting visualization, conceptual learning, spatial learning, kinesthetic learning, individual engagement offering learning environment which is similar to a natural

[13] According to the Frankfurt School, these artworks are characterized by unconventional character, many interconnected meanings, multiple interpretations and offer possibilities for in-depth exploration of the conditions and experiences of human existence (Kokkos, 2022).

collaborative learning environment (Matcha and Rambli, 2013, p.145). In the educational context, AR has proved to offer several advantages, i.e., increasing learning engagement and increasing understanding of some topics, especially when spatial skills are involved. Especially, (i) it has an ability to encourage kinesthetic learning, (ii) it can support students by inspecting the 3D object or class materials from a variety of different perspectives or angles to enhance their understanding, (iii) it increases the student level of engagement and motivation in academic activities, and (iv) it allows to provide contextual information, that is data about real objects of the scene related with the learning activity (Diaz et al., 2015, p.206).

The educational use of AR has been studied in all educational levels focusing both in formal and informal learning environments, and in different fields of education (medicine, science, engineering, history and social sciences, art education, foreign languages and distance learning (Boyles, 2017) with multiple benefits for teaching and learning (Tzima et al., 2019). As far as the utilization of AR in processes related to aesthetic experience is concerned, the applications of museums and art spaces offer visitor more opportunities to explore the artworks through augmented subjects, stories and details that overlap the original work facilitating its understanding (Panciroli et al., 2017, p.5). Finally, focusing on the exploitation of AR in transformative learning processes, the use of a number of AR tools enables students to actively engage, explore, and experiment with contemporary technology and engage in lifelong learning processes (Cowin, 2020, p.42). In this way, these tools seem to meet the requirements of transformative learning theories by transforming the educational process.

Design Process

Initial Idea and Goals

The initial idea emerged during the procedures of the European project iPEAR on Inclusive Peer Learning with Augmented Reality (i-pear.eu, 2023). During the program, a set of AR platforms were studied. The participants were invited to propose a framework for the use of augmented reality, choose the appropriate platform for the implementation of their idea and finally evaluate the selected platform.

From the study of the relevant literature emerged the idea of creating a transformative learning course through aesthetic experience including an AR experience, which will provide a more attractive learning experience, offer more possibilities for exploration and discovery to trainees and promote peer learning. In particular, the goals of the course being designed were (1) to emphasize and promote the role of the tutor in facilitating collaborative learning, (2) to utilize technology and especially the AR experience so as to make the trainees active learners and subsequently lead them to a meaningful dialogue with more opportunities for reflection and metacognition, (3) to enhance the

transformation process and finally (4) to enable learners to assimilate the provided information.

The Concept

The concept of the course being designed was a transformative learning process through aesthetic experience consisted of two parts: (1) an AR experience that participants would carry out at the beginning of the course and (2) an interactive talk which would take place after the AR experience and would be conducted by the tutor.

In both parts, the artworks are used as starting points facilitating the procedure. The interactive talk starts with the analysis of the artworks and through this analysis a debate analyzing the main topic takes place as well. The tutor plays a vital role in creating an inclusive and supportive environment, facilitating, and guiding the process in such a way that promotes peer learning, as it is described in Paragraph 2.

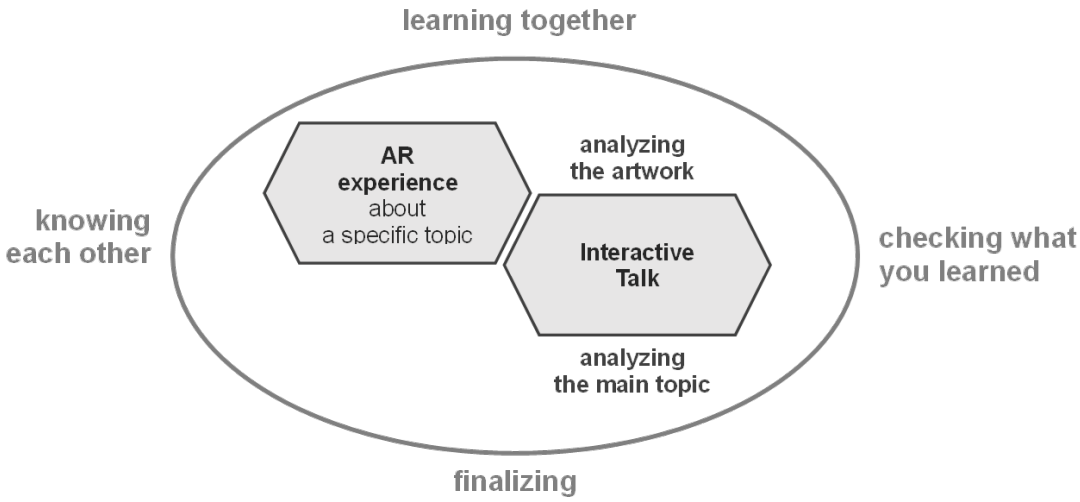


Figure 7. Schema of the course

The whole course gives the opportunity to the participants to try the same AR experience, know each other, share their knowledge, check what they have learned and finalize the peer learning process, becoming active peer learners. The process of interactive talk plays a crucial role in promoting reflection and metacognition.

Design of the Course

The design of the course took place in three stages: (1) Determination of the topic and the subtopics as well as study of the relevant literature in order to extract the necessary information about the examined subject that should be highlighted during the course. (2) Selection of the artworks and analysis of their specific features that would be utilized during the course. (3) Design of the AR experience and especially the scenario, the content, and the interactions, as well as final implementation of the AR experience using the selected tool. The tool that selected for the implementation was the online platform V-director by Vidinoti (Vidinoti - a Bigtincan Company, 2022) as an easy-to-use tool which offers the possibility to export the AR experience as a QR while the downloading of the corresponding V-Player and scanning the QR are the only requirements. (4) Design of the interactive talk in order to record the instructions and directions to be given as well as the information and prompts to be provided by the tutor to support and facilitate the process of the interactive talk and especially the active listening and discussion.

The Final Course

The main topic of the course was ecology and more specifically forest fires. Forest fires is one of the major environmental disasters that has had serious consequences for the ecosystem, emergency services, biodiversity as well as humans. (Wang et al., 2021). Subtopics and critical questions that are examined during the course are shown in Table 1.

Ecology – Forest Fires	
subtopics	- Causes and impacts of forest fires - Forest fires in countries of the Mediterranean - Prevention and Restoration practices - Reforesting - Climate change
critical questions	- How do I feel about burnt forests? What thoughts do I have when I see a burnt tree? - Who is responsible for burning forests? - Why are forests important and what do they offer to humans? - After a disaster can forest be restored and to what extent? - How much does forest burning concern us? - What can I do and how feasible is it to help protect forests?

Table 2. Subtopics and Critical Questions on the topic of Forest Fires

AR Experience

The AR experience is based on a poster/map of symbols which is used as a triggered image and consists of a number of symbols/signs of interest. The signs of interest are transformed to augmented clickable buttons and become visible by scanning the whole poster (Figure 8(a)). By tapping each button, a different work of art is revealed as well as a number of messages and questions which help participants to think critically (Figure 8(b)). Symbols, paintings, texts, and questions of the scenario of the AR experience are shown in Table 2.

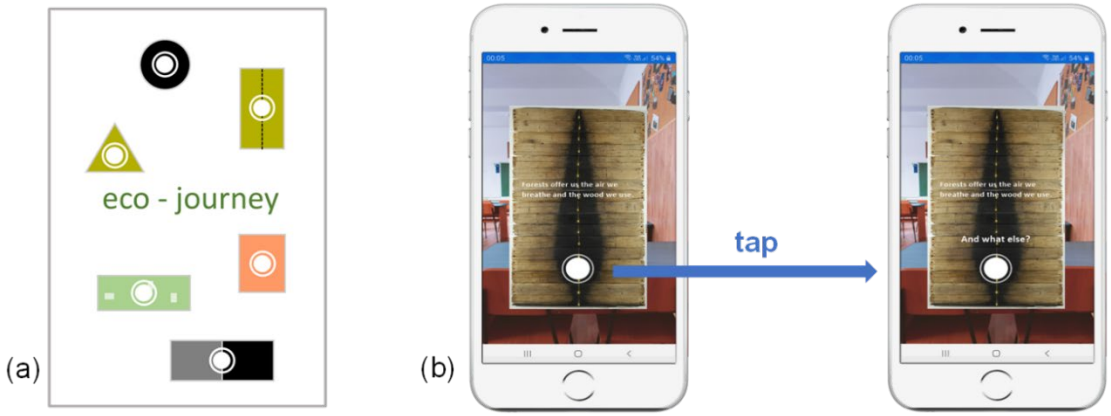


Figure 8. (a) Map of symbols transformed to augmented clickable buttons and (b) Screens of the AR experience

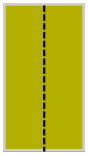
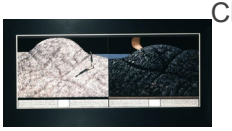
Symbol	Painting	Messages/ Questions
	 *Christakis Tassos* ***Tree*** *(1947)*	This is a burnt lonely tree. How do you feel when you see a burnt tree?
	 *Bokoros Christos* **Cypress of Memory** (2002)	Forests offer us the air we breathe and the wood we use. And what else?
	 *Tsoclis Kostas* **We Are All Responsible** (1972)	Newspapers often report on fire events and on ways to protect the environment. But we don't care. Why?
	 *Gaitis Yannis* **Composition** (1975)	We are focused on our everyday activities that we don't care about the forests. How often do you think of things you can do to protect trees from burning?
	 *Hatzikyriakos Ghikas Nikos* **Kifissia** (1973)	Can you imagine these beautiful areas without the trees?
	 Chouliaras Nikos **The Warm Desert of Life** (1996)	Our forest is in danger. Our planet is becoming unfriendly. Are you ready for climate change? Are you ready to live without oxygen?

Table 3. Scenario of the AR experience

Note that symbols were created to be visually linked to the artworks. The user can interact by tapping an image or an augmented button while different effects are used such as the recolour of images by tapping on them, and the recomposition of other images that gradually become visible during the experience.

Interactive Talk

The interactive talk begins with the observation of the first painting that participants have seen during the AR experience. The tutor invites the participants to analyze the artwork and more specifically to identify the specific features, the messages that it conveys or communicates, the emotions that may evoke to the viewer, the techniques that are used and what the artist is trying to express with it.

Subsequently, a conversation about the main topic and subtopics in relation to the examined painting is facilitated by the tutor who asks questions and provides participants with useful information. These elements contribute to the examination of the critical questions that have been posed during the AR experience and to the transformation process. This pattern is repeated for each work of art.

All the information about the artworks that provided by the tutor was obtained from the official website of the National Gallery of Athens (National Gallery - Alexandros Soutsos Museum, 2022). Data concerning forest fires were extracted from the websites of the WWF (World Wildlife Fund (WWF), 2022) and the Greek Ministry for Climate Crisis and Civil Protection for forest protection (Ministry for Climate Crisis and Civil Protection, 2022). Indicatively, the information provided during the analysis of the painting "Cypress of Memory" is presented in Table 3.

Examination of the painting "Cypress of Memory" - Information	
	**About the artwork** - *Cypress on wood (materials)* - *Burning of the wood* - *Memory / Death* **About fires** - *Constant fires, grazing on burnt land, and erosion impede the Mediterranean nature from being restored naturally, and there is always the risk of desertification* - *For technical, scientific, or economic reasons, not all areas can be reforested* - *Reforesting is a restoration practice, not a preventative one*

Table 4. Information that is provided by the tutor during the interactive talk

The course that created was presented to the other participants of the iPEAR program followed by a discussion. First impressions were recorded, and first conclusions were drawn, regarding the concept of the course, the contribution of the AR experience to peer learning, the effectiveness of the transformative learning process, as well as the selected AR platform.

Conclusions

As digital technology, and especially AR is increasingly being utilized in educational practice, the concept of the designed course seems to be very promising. Furthermore, the use of existing educational AR platforms makes the creation of an AR experience an easy and creative procedure. As a result, tutors can design and create by themselves the educational material and adapt it to the needs of the course.

Regarding the design and implementation of the AR experience, the selection of the V-director platform was generally successful as it is an easy-to-use tool, with a simple interface. In addition, the map of the user journey (scenario) provided by the platform is very useful for the supervision of the whole experience. As weak points we refer to the difficulty of the system to recognize a triggered image consisting of simple shapes and the lack of asset library.

As far as the concept of the designed course is concerned, all the participants who attended the presentation of the course agreed that the AR experience will offer a more personal and immersive experience that will help trainees to understand the main topic and think critically before taking part in the interactive talk. After the AR experience, trainees will feel as independent explorers/travelers who had the same experience and will be ready to share their thoughts engaging in a meaningful dialogue.

First implementation of the course to a small group of students showed positive acceptance and response related to the transformative learning process and the assimilation of the information given and can be found in (Barakari and Dimitra, 2023). Future pilot implementation of the idea of the course is of major importance to draw conclusions about the efficiency of the process and do the appropriate adaptations and optimizations. It is also self-evident that the concept would be applied to different contexts and levels of education with the appropriate modifications provided that teachers will be trained to design and create their own AR experiences and apply them to the classroom.

In conclusion, this study highlighted that the utilization of digital technology and in particular the creation of an AR experience in combination with the method of transformative learning creates the appropriate environment and conditions for the implementation of the peer educational strategy with the active participation of the learners in the educational process and the collaborative learning. It remains to be seen whether this combination could replace traditional teaching and to what extent could constitute a new, more effective educational reality.

REFERENCES

Akcayir, M. and Akcayir, G. (2017) 'Advantages and Challenges Associated with Augmented Reality for Education: A Systematic Review of the Literature.', Educational Research Review, 20, pp.1–11. https://doi.org/10.1016/j.edurev.2016.11.002

Azuma, R. (1997) 'A Survey of Augmented Reality', Presence: Teleoperators and Virtual Environments ,6, pp.355–385. https://doi.org/10.1162/pres.1997.6.4.355

Barakari, S., and Dimitra, A. (2023) 'Utilizing Augmented Reality to a Transformative Learning Process', in Chiou, V., Geunis, L., Holz, O., Ertürk, N.O., Ratkowska-Pasikowska, J., and Shelton, F. (eds.) Contemporary Challenges in Education - Paradoxes and Illuminations. Germany: Waxmann, pp. 400-415.

Boud, D., Keogh, R. and Walker, D. (1985) Reflection Turning Experience into Learning. London: Routlege.

Boud, D. and Lee, A. (2005) ''Peer learning' as pedagogic discourse for research education', Studies in Higher Education, 30(5), pp. 501–516. https://doi.org/10.1080/03075070500249138

Bruffee, K. (1999) Collaborative Learning: Higher Education, Interdependence, and the Authority of Knowledge.2nd ed.. London: John Hopkins University Press.

Boyles, B. D. (2017). Virtual Reality and Augmented Reality in Education.

Chi, M.T.H., Bassok, M., Lewis, M.W., Reimann, P. and Glaser, R. (1989) 'Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems', Cognitive Science, 13(2), pp.145–182. https://doi.org/10.1207/s15516709cog1302_1

Chun, J. and Cennamo, K. (2022). 'A Theoretical Model of Peer Learning Incorporating Scaffolding Strategies', International Journal of Teaching and Learning in Higher Education 2022, 33(3), pp.385–397. Available at: https://files.eric.ed.gov/fulltext/EJ1366167.pdf [Accessed 10 Jun. 2023].

Cowin, J. B. (2020) 'Digital Worlds and Transformative Learning: Google Expeditions, Google Arts and Culture, and the Merge Cube', International Research and Review, 10(1), pp. 42–53.

Cranton, P. (2006) 'Fostering Authentic Relationships in the Transformative Classroom', New Directions for Adult and Continuing Education, 109, pp. 5–13. https://doi.org/10.1002/ace.203

Dewey, J. (1934) Art as experience. New York: Balch & Company.

Dewey, J. (1938) Experience and education, New York: Macmillan Company.

Diaz C., Hincapié M. and Moreno G. (2015) 'How the Type of Content in Educative Augmented Reality Application Affects the Learning Experience', Procedia Computer Science, 75, pp. 205-212. https://doi.org/10.1016/j.procs.2015.12.239

Dillenbourg, P. (2000) Collaborative Learning: Cognitive and Computational Available at: https://www.researchgate.net/publication/37467078_Collaborative_Learning_Cognitive_and_Computational_Approaches (Accessed: 2 June 2023)

Flavell, J. H. (1979) 'Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry', American Psychologist, 34(10), pp. 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Freire, P. (1970) Pedagogy of the Oppressed, New York: Seabury Press.

Freire, P. (1968) 'L'Éducation, praxis de la liberté: une étude du mouvement d'alphabétisation et d'éducation de base au Brésil.', Archives Internationales de Sociologie de La Coopération et Du Développement, 23, pp. 4–29.

Giroux, H. A. (2010) 'Rethinking Education as the Practice of Freedom: Paulo Freire and the Promise of Critical Pedagogy', Policy Futures in Education, 8(6), pp. 715–721. https://doi.org/10.2304/pfie.2010.8.6.715

Gopalan, V., Abubakar, J., Zulkifli, A. N., Alwi, A., and Che Mat Ruzinoor, P. (2017) 'A review of the motivation theories in learning', AIP Conference Proceedings, 1891(1), pp. 020043-1–020043-7. https://doi.org/10.1063/1.5005376

Halpern, D. F. (2014) Thought and knowledge: An introduction to critical thinking. 5th ed.. New York: Psychology Press.

Hohr, H. (2013) 'The Concept of Experience by John Dewey Revisited: Conceiving, Feeling and "Enliving."', Studies in Philosophy and Education, 32, pp. 25–38. https://doi.org/10.1007/s11217-012-9330-7

Jaramillo J.A. (1996), 'Vygotsky's Sociocultural Theory and Contributions to the Development of Constructivist Curricula.', Education 3-13, 117 (1), pp. 133–140.

Kokkos, A. (2022) 'Transformation of assumptions through the use of art: Activating an educational method', in Kostara, E. Gavrielatos, A.and Loads, D. (eds.) Transformative Learning Theory and Praxis: New Perspectives and Possibilities. London: Routledge. pp.95-109.

Liu, C.-Y and Chen, H.-L. (2020) 'Effects of peer learning on learning performance, motivation, and attitude', International Journal of Education Economics and Development, 11(4), pp. 420-443. https://doi.org/10.1504/IJEED.2020.110599

Matcha, W. and Rambli, D.R.A. (2013) 'Exploratory Study on Collaborative Interaction through the Use of Augmented Reality in Science Learning', Procedia Computer Science, 25, pp.144-153. https://doi.org/10.1016/j.procs.2013.11.018

Mercer (2000) Words and Minds: How We Use Language to Think Together. London: Routledge.

Mercer, N. and Littleton, K. (2007) Dialogue and the Development of Children's Thinking. UK: Routledge.

Mezirow, J. (1978) 'Perspective transformation', Adult Education, 28(2), pp.100–110. https://doi.org/10.1177/074171367802800202

Mezirow, J. and Associates (1990) Fostering Critical Reflection in Adulthood: A Guide to Transformative and Emancipatory Learning. San Francisco, CA: Jossey-Bass.

Mezirow, J. (2009) 'An overview on transformative learning' in Illeris, K. (Ed.) Contemporary Theories of Learning: Learning Theorists -- In Their Own Words. London:Routledge, pp. 90-105.

Ministry for Climate Crisis and Civil Protection (2022). Forest Fires. Available at: https://www.civilprotection.gr/en/forest-fires (Accessed: 10 June 2023).

Moreno-Guerrero, A.-J., Alonso García, S., Ramos Navas-Parejo, M., Campos-Soto, M. N., and Gómez García, G. (2020) 'Augmented Reality as a Resource for Improving Learning in the Physical Education Classroom', International Journal of Environmental Research and Public Health, 17(10), 3637. https://doi.org/10.3390/ijerph17103637

National Gallery - Alexandros Soutsos Museum (2023). Permanent Exhibition - National Gallery. Available at: https://www.nationalgallery.gr/en/monimi-ekthesi/ (Accessed: 10 June 2023).

i-pear.eu, (2023). i-pear.eu-Welcome. Available at: https://i-pear.eu/ (Accessed: 3 June 2023).

Palincsar, A. S. and Brown, A. L. (1984) 'Reciprocal Teaching of Comprehension-Fostering and Comprehension-Monitoring Activities', Cognition and Instruction, 1(2), pp.117–175. https://doi.org/10.1207/s1532690xci0102_1

Panadero, E., Jonsson, A. and Botella, J. (2017) 'Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses' , Educational Research Review, 22, pp.74-98. https://doi.org/10.1016/j.edurev.2017.08.004

Panciroli, C., Macauda, A., and Russo, V. (2018) 'Educating about Art by Augmented Reality: New Didactic Mediation Perspectives at School and in Museums', Proceedings of the International and Interdisciplinary Conference IMMAGINI? Brixen, Italy, 27–28 November 2017, 1(9), 1107. https://doi.org/10.3390/proceedings1091107

Sadler, D.R. (2010) 'Beyond feedback: developing student capability in complex appraisal', Assessment & Evaluation in Higher Education, 35(5), pp.535–550. https://doi.org/10.1080/02602930903541015

Schraw, G. and Moshman, D. (1995) 'Metacognitive theories', Educational Psychology Review, 7(4), pp. 351–371. https://doi.org/10.1007/BF02212307

Tisdell, E. J., & Thompson, P. M. (2005) The Role of Pop Culture and Entertainment Media in Adult EducationPractice. Available at: https://newprairiepress.org/aerc/2005/papers/6/

(Accessed: 3 June 2023).

Topping, K. (2005) 'Trends in Peer Learning Peer Tutoring: A Training and Development Manual', Educational Psychology, 25(6), pp. 631-645. https://doi.org/10.1080/01443410500345172

Tzima, S., Styliaras, G. and Bassounas, A. (2019) 'Augmented Reality Applications in Education: Teachers Point of View', Education Sciences, 9(2), 99. https://doi.org/10.3390/educsci9020099

Vessel, E., Starr, G., and Rubin, N. (2013) 'Art reaches within: aesthetic experience, the self and the default mode network', Frontiers in Neuroscience, 7, 258. https://doi.org/10.3389/fnins.2013.00258

Vidinoti - a Bigtincan Company (2022). Vidinoti. Available at: https://www.vidinoti.com/en/home/ (Accessed: 10 June 2023).

Wang, S. W., Lim, C.-H., & Lee, W.-K. (2021) 'A review of forest fire and policy response for resilient adaptation under changing climate in the Eastern Himalayan region', Forest Science and Technology, 17(4), pp. 180–188. https://doi.org/10.1080/21580103.2021.1979108

World Wildlife Fund (WWF) (2022) FIRES. Available at: https://www.wwf.gr/en/our_work/nature/terrestrial/programmes/fires/ (Accessed: 10 June 2023).

Zimmerman, B.J. and Schunk, D.H. (2001) Self-regulated learning and academic achievement: Theoretical perspectives. 2nd ed.. New York: Routledge.

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