World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

Check for updates

Augmented reality in vocational and general education: The XRinVET project

Irini Chaidi [1], Marios Pitikakis [2], Pantelis Pergantis [1], Antonis Christou [3] and Athanasios Drigas [1,*]

[1] *Net Media Lab Mind-Brain R&D, IIT, NCSR Demokritos, Greece.*
[2] *Department of Computer Science; University of Crete. Greece*
[3] *Department of Special Education, University of Thessaly, Greece.*

World Journal of Advanced Research and Reviews, 2025, 25(02), 2535-2542

Publication history: Received on 16 January 2025; revised on 22 February 2025; accepted on 25 February 2025

Article DOI: https://doi.org/10.30574/wjarr.2025.25.2.0617

Abstract

Extended technology Reality (XR), which includes Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), is revolutionizing the education sector, radically changing the way students and professionals acquire knowledge and skills.

Keywords: Augmented Reality (XR); Vocational Education (VET); General Education; Xrinvet Project

1. Introduction

Augmented Reality (AR) is a technology with great potential that can change how we interact with the world around us. It is a technology that combines the real world with digital elements, creating an enriched and interactive experience for the user. Unlike Virtual Reality (VR), which creates a completely virtual world, AR focuses on enhancing reality with digital information. With the continuous development of technology, AR is expected to play an important role in many areas in the future in education, both general and vocational, as well as in the education of people with disabilities.

1.1. Definition and Characteristics of Augmented Reality (X R)

Augmented Reality (X R) is a technology that allows the user to interact with the real world, which is enriched with digital elements, such as images, video, audio, and 3D models. Augmented Reality (XR) is a revolutionary technology that combines the digital world with the real world, creating an experience that enriches the user's perception and interaction with the environment. XR includes a range of technologies, such as Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR).

1.1.1. The XR Features are summarized below

- Combining the real and digital worlds: X R combines the real world with digital elements, creating a new, enriched reality.
- Real-time interaction: The user can interact with the digital elements in real-time, creating an interactive experience.
- 3D Graphics: X R often uses 3D graphics to create a more realistic and immersive experience.
- Use of multiple senses: X R can use multiple senses, such as vision, hearing, and touch, to create a more complete experience.
- Diverse applications: X R has applications in many sectors, such as education, entertainment, health, industry and retail

* Corresponding author: Athanasios Drigas.

Augmented Reality (AR) has emerged as a revolutionary technology with the potential to radically transform vocational education and training (VET). By combining the digital and real worlds, AR offers a range of benefits that can improve learning effectiveness, enhance learners' readiness for the job market, and promote lifelong learning.

1.2. The Theoretical Basis of XR in Education

The use of XR in education is based on pedagogical theories that emphasize experiential and active learning.

- The Power of Experiential Learning Learning): David Kolb (1984) developed the theory of experiential learning, which states that knowledge is acquired when people interact directly and learn best through experience. XR technologies enable learners to experiment, make decisions, and learn by doing, by training through simulations that simulate real-world work situations, allowing them to learn by doing, creating realistic simulation environments that enhance understanding and skill development (Kolb, 1984). XR simulations allow learners to actively participate and develop skills through trial and error, without the risk of real-world mistakes in the workplace. According to John Dewey, learning is not a simple transfer of information but a dynamic process of interaction.

- XR as a Transformative Agent in Education - Constructionism: Seymour Papert (1980), the father of constructionism, influenced by Jean Piaget, who developed the theory of constructivist learning, argued that students learn best when they create and interact with objects and manipulate mental objects - ideas. XR applications allow learners to construct virtual models, manipulate digital tools, and learn through trial and error (Papert, 1980).

XR technology gives them exactly that opportunity, allowing them to build virtual models, interact with complex machines, or even perform surgeries in a safe, virtual environment. Donald Sch ö n, through the concept of “reflective practitioner”, emphasizes the importance of reflection in learning.

- Vygotsky's Sociocultural Theory: Lev Vygotsky (1978) emphasized the importance of social interaction in learning, introducing the concept of the Zone of Proximal Development (ZPD). XR facilitates collaborative learning by allowing students to interact in virtual classrooms and work environments, where they can develop knowledge and skills with the guidance of instructors and peers (Vygotsky, 1978).

VR and AR tools allow learners to observe and analyze their actions through repeated simulations and feedback data.

1.3. Augmented Reality in distance and e-learning

Augmented Reality (AR) has the potential to revolutionize distance and e-learning, offering several advantages that enhance the learning experience and make it more effective.

1.3.1. Advantages of EP in distance and e-learning:

- Enhancing interaction and participation: ML allows students to interact with digital content more naturally and intuitively, making learning more engaging and interesting.
- Improving understanding and retention of knowledge: EP provides the ability to create 3D models and simulations that help students understand complex concepts more easily and memorize them for a longer period of time.
- Creating personalized learning experiences: EP can adapt to the needs and preferences of each student, offering personalized learning experiences that maximize the effectiveness of education.
- Accessibility and flexibility: EP makes learning more accessible to all students, regardless of their geographical location or physical abilities. In addition, EP offers greater flexibility to students, as they can learn at their own pace and time.

1.3.2. Applications of EP in distance and e-learning:

- Virtual classrooms and workshops: EP can be used to create virtual classrooms and workshops where students can participate in interactive activities and collaborate with their classmates.
- 3D models and simulations: The EP provides the ability to create 3D models and simulations that help students more easily understand complex concepts and apply them to real-world situations.
- Educational games and apps: EP can be used to create educational games and apps that make learning more fun and engaging.

- Remote Internship: The OP allows students to practice their skills in virtual environments that simulate real-world work conditions.

2. Augmented reality in education

Augmented Reality (AR) has emerged as a promising technology with the potential to transform the educational experience. Many studies have examined the application of AR in various areas of education, highlighting its advantages and challenges. XR has the potential to transform the educational process, offering a range of advantages in both vocational and general education. Augmented Reality (AR) has the potential to revolutionize the way we learn and teach. By combining the digital world with the real world, AR creates a more engaging, interactive, and effective learning experience.

2.1. The Advantages of EP in education are the following:

- Enhance learning through experiential learning: VR allows students to interact with 3D models and simulations, making learning more engaging and effective. Students can explore an ancient monument, "see" how the human body works or experiment with scientific concepts in a way that would not be possible with traditional teaching methods.
- Improve comprehension and retention: VR provides the ability to create personalized learning experiences that are tailored to each student's needs and preferences. Additionally, interacting with digital content through VR helps students understand complex concepts more easily and remember them for longer.
- Developing practical skills: In vocational education, VR can be used to simulate real-world work conditions, allowing students to practice their skills in a safe and controlled environment.
- Accessibility and flexibility: EP makes learning more accessible to all students, regardless of their geographical location or physical abilities. In addition, EP offers greater flexibility to students, as they can learn at their own pace and time.
- Facilitating collaboration: XR can create virtual environments where students can collaborate and interact with each other, developing social and communication skills.

2.2. Some Examples of applications of EP in education for a better approach to knowledge are referred to:

- Medical Education: Medical students can use VR to examine 3D models of the human body and practice surgical procedures in virtual environments, "watch" a virtual surgery, or practice medical procedures.
- Engineering Education: Engineering students can use VR to design and test virtual prototypes of machines and structures, "explore" the inner workings of a machine, or "visit" a construction site.
- Tourism Education: Tourism students can use VR to explore virtual tourist attractions and prepare for their work, to "learn" about the history and culture of a place, or to "prepare" for receiving tourists.
- History Education: Students can "travel" back in time and "experience" historical events, "meet" historical figures, or "explore" ancient civilizations.

2.3. XR in General Education

Research shows that using XR in the classroom increases student interest and participation, as Huang, Rauch & Liaw (2010) report that virtual experiences enhance cognitive processing and memory retention (Huang, Rauch & Liaw, 2010).

2.3.1. In general education, XR can be used in various subjects

- History: Students can visit historical monuments through VR tours.
- Biology: XR applications allow for 3D exploration of the human body.
- Physics: Students can experiment with phenomena such as gravity and electromagnetism in virtual labs.

2.3.2. Despite the significant benefits, integrating XR into education faces challenges, such as

- High equipment costs (VR headsets, AR devices).
- Need for training of teachers in the use of XR tools.
- Managing technology in the educational process. However, with the evolution of technology, XR is becoming more accessible and easier to use, making it a key tool of the future in education.

2.4. Augmented Reality in Vocational Education: A Tool for the Future

Augmented Reality (AR) has emerged as a revolutionary technology with the potential to radically transform vocational education and training (VET) by making learning more engaging, effective, and accessible. By addressing the challenges and further developing the technology, AR is expected to play a significant role in the future of VET. By combining the digital world with the real world, AR offers a number of advantages that can improve learning effectiveness, enhance learners' readiness for the demands of the modern labor market and promote lifelong learning.

2.4.1. Advantages of AR in Vocational Education are the advantages mentioned in general education adapted to

- Enhancing learning through experiential experience: to "experience" real working conditions in a safe and controlled environment, acquiring practical skills before entering the job market.
- Improving understanding and retention of knowledge: through personalized learning experiences, it helps learners understand practical skills that will benefit them in their professional journey.
- Developing practical skills: XR can be used to simulate real-world work situations. For example, an apprentice engineer can use AR to "assemble" an engine, or a future surgeon can practice performing a virtual operation.
- Accessibility and flexibility: XR can adapt to the needs of each student, offering personalized learning experiences and making education more accessible for everyone.

2.4.2. Applications of XR in Vocational Education are carried out through

- Virtual labs and simulations: XR can be used to create virtual labs and simulations that simulate real-world work conditions. This allows learners to practice their skills in a safe and controlled environment, without the risk of injury or damage to expensive equipment.
- Real-time training: AR can be used to provide real-time training, allowing learners to receive instructions and information while working in a real-world work situation. For example, a technician repairing a machine can use AR to view a 3D model of the machine and receive instructions on how to repair it.
- Distance learning: XR can be used to deliver distance learning, allowing learners to learn from anywhere, anytime. For example, an instructor can use AR to create a virtual lesson that learners can take from home.

Despite its many advantages, XR in vocational education faces some challenges, such as the need for high-quality educational content, ensuring accessibility, and teacher training. However, the continuous development of technology and the increasing demand for quality vocational education create new opportunities for the further exploitation of XR in the VET sector.

2.4.3. In professional education, XR technology allows training in realistic work environments without physical constraints. For example:

- Engineers and technicians can practice on simulated machines and factories, without the cost and risk of physical training.
- Healthcare professionals can be trained in surgical procedures through VR, avoiding the need for real patients.
- Trainees in sectors such as hospitality and tourism can experience realistic customer service scenarios through XR applications.

According to Radianti and al. (2020), XR in professional education improves performance, confidence, and knowledge retention by allowing learners to practice in realistic, interactive situations (Radianti and al ., 2020).

2.5. Augmented reality and special education: an acceptance study and an application design model

Augmented Reality (AR) has the potential to revolutionize the way students with special educational needs (SEN) learn and are taught. By combining the digital world with the real world, AR creates a more engaging, interactive, and personalized learning experience for these students.

2.5.1. The advantages of HR in special education and training can be summarized as follows

- Enhancing learning through experiential learning: RP allows students with SEN to interact with 3D models and simulations, making learning more engaging and effective. For example, a student with autism can use RP to explore a social scenario in a safe and controlled environment, while a student with learning disabilities can use RP to "build" a word or a mathematical concept.
- Improve comprehension and retention: HR provides the ability to create personalized learning experiences that are tailored to the needs and preferences of each student with ASD. Additionally, interacting with digital content through HR helps students understand complex concepts more easily and remember them for longer.
- Developing social and emotional skills: EP can be used to help students with SEN develop social and emotional skills, such as communication, collaboration, and self-esteem. For example, a student with ADHD can use EP to practice social interactions, or a student with behavioral problems can learn to recognize and manage their emotions.
- Accessibility and flexibility: HR makes learning more accessible for all students with EAP, regardless of their geographical location or physical abilities. In addition, EP offers greater flexibility to students, as they can learn at their own pace and time.

A study investigating the acceptance of HR by students with SEN and teachers has shown that the majority of participants consider HR to be a useful and effective technology for education. However, the study has also highlighted the need for the development of high-quality educational content that is tailored to the needs of students with SEN.

To develop effective HR applications for students with SEN, it is important to follow a design model that takes into account the specificities and needs of these students. Such a model should include the following elements:

- Assessing the student's needs: Before developing any application, it is important to assess the student's needs, learning difficulties, and capabilities.
- Design of the application: The application should be designed in a way that is attractive and interesting to the student, taking into account their learning needs and preferences.
- Content development: The content of the application should be high quality, educational, and tailored to the needs of the student.
- Evaluating effectiveness: After developing the application, it is important to evaluate its effectiveness in improving student learning and development.

2.6. XRinVET (Extended Reality in Vocational Training)

A new important project Erasmus+, XRinVET (Extended Reality in Vocational Training), coordinated by the University of Crete and partnered by Demokritos-ITT-Netmedialab Demokritos, will develop Portal and e-learning XR applications with the main goal of creating augmented reality applications for vocational training!! Participating also the agencies CODEARRAYS LTD, CHAMBRE DE COMMERCE BELGOITALIENNE, CONFEDERATION ESPANOLA DE CENTROS DE ENSENANZA ASOCIACION CECE, DIRECTORATE OF SECONDARY EDUCATION OF PELLA

The XRinVET (Extended Reality in Vocational Education and Training) project aims to utilize and integrate these technologies to improve vocational education and training (VET), as well as general education, by introducing new learning methods through an innovative and experiential approach to learning.

- The Benefits of XRinVET in Vocational Education
- The XRinVET project develops and implements XR solutions to address challenges in traditional vocational education. Among its key benefits are:
- Increased student engagement: XR experiences are more engaging and interactive compared to traditional educational media.
- Safe practice: Students can train in dangerous or difficult environments without real risks.
- Resource savings: XR simulations reduce the need for expensive physical materials and equipment.
- Personalized learning: Students can progress at their own pace and receive immediate feedback.

Conclusion XRinVET is here to bring the next revolution in vocational education, bridging the gap between theory and practice. As Lev Vygotsky argued, learning is a social process and technology can create new environments for collaboration and skill development. With the power of XR, vocational education becomes more effective, dynamic, and adapted to the needs of the modern labor market. The XRinVET project aims to transform vocational and general education through XR technologies, based on modern pedagogical theories.

As John Dewey noted, "education is not preparation for life – it is life itself" (Dewey, 1938). With XR, education becomes more experiential, engaging, and effective, better-preparing students for the demands of the modern world.

Summarizing, we want to emphasize the value of all digital technologies in the field of education. ICTs enable universal education, provide new techniques for effective teacher training, enhance memory retention, promote cooperation, increase transparency, develop learner-centered strategies, develop new teaching techniques, and quicken learning. Additionally, through virtualization, mobilization, artificial intelligence, and new learning environments-worlds, give new instruments for knowledge representation and support educational activities and methodologies. More specifically, ICTs are very effective and productive in ADHD training, facilitating and improving the assessment, intervention, and educational procedures via mobile devices that bring educational activities everywhere [17] and through a variety of ICT applications that are the main supporters of education [18-21]. While games turn education into a multimodal, incredibly amiable, and enjoyable interaction, the use of AI, STEM, and ROBOTICS raises educational procedures into new levers of adaptation, creativity, and performance [22-26]. Additionally, the adoption, enhancement, and blending of ICTs with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [27-33] brings the mental abilities to the center of the educational procedures and policies, and as a result, accelerates and improves the educational practices and outcomes, particularly in minority children with ADHD, treating domain and its practices like assessment and intervention.

3. Conclusions

Augmented Reality (XR) is a promising technology that can transform distance and e-learning, making it more effective, engaging, and accessible. By addressing the challenges and further developing the technology, XR is expected to play a significant role in the future of education. Especially in the future of VET, preparing learners for the demands of the modern labor market and promoting lifelong learning. However, the widespread adoption of XR in education requires addressing challenges such as developing quality educational content, ensuring accessibility, and training teachers.

HR can also revolutionize special education and training. By developing high-quality educational content and implementing an effective design model, HR can help students with SEN develop their potential and achieve their learning goals.

Despite its many advantages, X R in vocational education faces some challenges, such as the need for high-quality educational content, ensuring accessibility, and teacher training. However, the continuous development of technology and the increasing demand for quality vocational education create new opportunities for the further exploitation of X R in the VET sector.

Compliance with ethical standards

Acknowledgments

The Authors would like to thank the SPECIALIZATION IN ICTs AND SPECIAL EDUCATION: PSYCHOPEDAGOGY OF INCLUSION Postgraduate studies Team, for their support.

Disclosure of conflict of interest

The Authors proclaim no conflict of interest

References

[1] Dewey, J. (1938). Experience and Education. New York: Macmillan.

[2] Huang, HM, Rauch, U., & Liaw, SS (2010). Investigating learners' attitudes towards virtual reality learning environments: Based on a constructivist approach. Computers & Education, 55(3), 1171-1182.

[3] Kolb, DA (1984). Experiential Learning: Experience as the Source of Learning and Development. Englewood Cliffs, NJ: Prentice Hall.

[4] Papert, S. (1980). Mindstorms: Children, Computers, and Powerful Ideas. New York: Basic Books.

[5] Radianti, J., Majchrzak, TA, Fromm, J., & Wohlgenannt, I. (2020). Virtual reality in education: A meta-review and research agenda. Computers & Education, 147, 103778.

[6] Vygotsky, LS (1978). Mind in Society: The Development of Higher Psychological Processes. Cambridge, MA: Harvard University Press.

[7] Ronald T. Azuma: He is considered one of the pioneers of AR and has contributed significantly to the development of the technology.

[8] Ivan Sutherland: One of the pioneers of computing and computer graphics, who has also contributed to the development of AR.

[9] Wikipedia: Wikipedia provides an overview of Augmented Reality, including its features, applications, and history.

[10] EdTech: EdTech provides information on Augmented Reality and its applications in education.

[11] Big Blue Data Academy: Big Blue Data Academy provides a definition and examples of Augmented Reality.

[12] Papaki Blog: Papaki Blog provides information on Augmented Reality, including its definition, characteristics, and examples.

[13] Augmented Reality in distance and e-learning (https://apothesis.eap.gr/archive/item/207355?lang=el)

[14] Augmented reality in education: a comparative study (https://polynoe.lib.uniwa.gr/xmlui/handle/11400/1442)

[15] The Use of Augmented Reality in Education (https://cs-msc.uop.gr/sites/default/files/2024-05/%CE%94%CE%B9%CF%80%CE%BB%CF%89%CE%BC%CE%B1%CF%84%CE%B9%CE%BA%CE%AE_%CE%95%CF%80%CE%B1%CF%85%CE%BE%CE%B7%CE%BC%CE%AD%CE%BD%CE%B7%20%CE%A0%CF%81%CE%B1%CE%B3%CE%BC%CE%B1%CF%84%CE%B9%CE%BA%CF%8C%CF%84%CE%B7%CF%84%CE%B1%20%CF%83%CF%84%CE%B7%CE%BD%20%CE%95%CE%BA%CF%80%CE%B1%CE%AF%CE%B4%CE%B5%CF%85%CF%83%CE%B7_2.4_%CE%BA.%CE%92%CE%B1%CF%83%CE%B9%CE%BB%CE%AC%CE%BA%CE%B7%CF%82.pdf)

[16] Augmented reality and special education: an acceptance study and an application design model (https://www.didaktorika.gr/eadd/handle/10442/54928)

[17] Stathopoulou A, Karabatzaki Z, Tsiros D, Katsantoni S, Drigas A, 2019 Mobile apps the educational solution for autistic students in secondary education , Journal of Interactive Mobile Technologies (IJIM) 13 (2), 89-101https://doi.org/10.3991/ijim.v13i02.9896

[18] Drigas A, Petrova A 2014 ICTs in speech and language therapy , International Journal of Engineering Pedagogy (iJEP) 4 (1), 49-54 https://doi.org/10.3991/ijep.v4i1.3280

[19] Alexopoulou, A., Batsou, A., & Drigas, A. S. (2019). Effectiveness of Assessment, Diagnostic and Intervention ICT Tools for Children and Adolescents with ADHD. International Journal of Recent Contributions from Engineering, Science & IT (iJES), 7(3), pp. 51–63. https://doi.org/10.3991/ijes.v7i3.11178

[20] Bamicha V, Drigas A, 2022 The Evolutionary Course of Theory of Mind - Factors that facilitate or inhibit its operation & the role of ICTs , Technium Social Sciences Journal 30, 138-158, DOI:10.47577/tssj.v30i1.6220

[21] Galitskaya, V., & Drigas, A. (2020). Special Education: Teaching Geometry with ICTs. International Journal of Emerging Technologies in Learning (iJET), 15(06), pp. 173–182. https://doi.org/10.3991/ijet.v15i06.11242

[22] Lytra N, Drigas A 2021 STEAM education-metacognition–Specific Learning Disabilities , Scientific Electronic Archives journal 14 (10) https://doi.org/10.36560/141020211442

[23] Demertzi E, Voukelatos N, Papagerasimou Y, Drigas A, 2018 Online learning facilities to support coding and robotics courses for youth , International Journal of Engineering Pedagogy (iJEP) 8 (3), 69-80, https://doi.org/10.3991/ijep.v8i3.8044

[24] Chaidi I, Drigas A 2022 Digital games & special education , Technium Social Sciences Journal 34, 214-236 https://doi.org/10.47577/tssj.v34i1.7054

[25] Pergantis, P., & Drigas, A. (2024). The effect of drones in the educational Process: A systematic review. Education Sciences, 14(6), 665. https://doi.org/10.3390/educsci14060665

[26] Chaidi, I., Pergantis, P., Drigas, A., & Karagiannidis, C. (2024). Gaming Platforms for People with ASD. Journal of Intelligence, 12(12), 122. https://doi.org/10.3390/jintelligence12120122

[27] V Galitskaya, A Drigas 2021 The importance of working memory in children with Dyscalculia and Ageometria , Scientific Electronic Archives journal 14 (10) https://doi. org/10.36560/141020211449

[28] Drigas A, Mitsea E, Skianis C. 2022 Virtual Reality and Metacognition Training Techniques for Learning Disabilities , SUSTAINABILITY 14(16), 10170, https://doi.org/10.3390/su141610170

[29] Drigas A,. Sideraki A. 2021 Emotional Intelligence in Autism , Technium Social Sciences Journal 26, 80, https://doi.org/10.47577/tssj.v26i1.5178

[30] Mitsea E, Drigas A,, Skianis C, 2022 Breathing, Attention & Consciousness in Sync: The role of Breathing Training, Metacognition & Virtual Reality , Technium Social Sciences Journal 29, 79-97 https://doi.org/10.47577/tssj.v29i1.6145

[31] Kontostavlou, E. Z., & Drigas, A. (2021). How Metacognition Supports Giftedness in Leadership: A Review of Contemporary Literature. , International Journal of Advanced Corporate Learning (iJAC), 14(2), pp. 4–16. https://doi.org/10.3991/ijac.v14i2.23237

[32] Drigas A, Mitsea E, Skianis C, 2022 Intermittent Oxygen Fasting and Digital Technologies: from Antistress and Hormones Regulation to Wellbeing, Bliss and Higher Mental States , Technium BioChemMed journal 3 (2), 55-73 80no107

[33] Chaidi, I., & Drigas, A. (2022). Social and Emotional Skills of children with ASD: Assessment with Emotional Comprehension Test (TEC) in a Greek context and the role of ICTs. , Technium Social Sciences Journal, 33(1), 146–163. https://doi.org/10.47577/tssj.v33i1.6857