

Augmented Reality in Teaching Technical/Vocational Skills in the 21st Century Classroom

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Abstract

The purpose of this paper is to explain Augmented Reality (AR) in the field of technical/ vocational education. To ensure that education system deliver quality education, it has to undergo tremendous changes through technology to provide an interesting, realistic and authentic learning environment through AR. AR is a technology that the ability to overlay computer graphics on the real environment. AR uses tools like smart phones in projecting virtual objects to the students covering different topics in technical/ vocational education. This paper captures the characteristics of AR which include mixing reality with digital information, being interactive, facilitates modification of text, video clips, audio, 3D and websites contents. The paper also looked into the benefits of AR in teaching and learning technical/ vocational education. The benefits includes enhancing interactive learning, increased student engagement, improved knowledge retention, personalized learning, real world application, gratification motivation, accessibility and inclusivity of learner's needs. The challenges facing the teaching and learning of AR ranges from challenges related to individual teachers, students, AR system developers, environment and lack of empirical studies were highlighted. Solutions on how to overcome the challenges of AR were proffered.

Keywords: Augmented reality, Technical/ vocational education and Technology

Introduction

The 21st century has brought about a rise in the use of technology to enhance instructional delivery and learning. This can help both teachers and students embrace innovative approaches. Augmented reality (AR) is an emerging technology which can be used to improve the learning experience of the students while making learning interesting and keeping students' attention (Hamid, Ismail and Yahaya, 2022). AR uses tools such as smartphones or tablets in projecting virtual objects for illustrating the proper use of techniques or showing the shape of a model onto a real environment (Ulfah and Azzah, 2018). AR as an upgraded version of virtual reality (VR) extends the actual environment by separating the user completely from the real world. While VR helps the user in the real and virtual worlds at the same time through smooth interface tools and application like head set, interactive glass, tablets and three-dimensional (3D) objects. The main difference between VR and AR is the reality because AR acts as a supplement to the real world. AR is a technology that overlays computer-generated virtual elements into the real-world environment, enhancing user's perception interaction with the physical world.

According to Ghailan and Muhammad (2021), AR consists of three main aspects: 1. The integration of real and virtual objects. 2. The integration of these three objects at the same time 3. The participation of real and virtual objects for the same task. Therefore, in technical and vocational education, AR can be applied to teach students with the help of

3D objects. The basic components of AR system are the camera, user interface, tracking system and visualization technologies.

Characteristics of Augmented Reality

The characteristics of AR compared to other technologies as outlined by Barro, Gutlemaz and Lorate, (2019) includes:

1. Being a mixed reality, enabling the enrichment the information in reality with digital information.
2. Integration occurs in real time and in cohesive manner.
3. It facilitates the modification of different resources, texts, websites, video clip, audio and 3D.
4. It is interactive. Users can manipulate the virtual AR objects in other ways than purely physical objects (Jule and Alexander, 2019).
5. In the creation of content, intervention from a person is necessary.

Benefits of Augmented Reality to Technical/ Vocational Education

The potential of AR has not been applied maximally and is still rarely used in vocational and technical education in Nigeria. Some of the benefits of AR to technical/ vocational education are:

1. Enhancing Interactive Learning

In technical/ vocational education, the traditional teaching methods are mostly lecture and demonstration methods. The students mostly remain passive learners. AR brings a dynamic shift in teaching and learning by offering enhanced interaction in learning opportunities. Through the integration of AR, students can actively engage with the subject matter by turning abstract concepts into tangible experience. AR can bring complex technical/ vocational phenomena to life by allowing students to visualize the 3D models or conduct virtual experiments (Muhammad, Mangina and Champel, 2022).

2. Increased Student Engagement

One of the major benefits of AR in technical/ vocational education is its ability to significantly increase student engagement. The traditional lecture, demonstration and text books can sometimes fail to capture students' attention. AR transforms the learning process by creating an exciting and interactive environment that increase students' interest. AR brings subjects to life through overlaying digital contexts into real world. For example, wood work lesson can be enriched with AR by allowing students to explore how timber is processed virtually. The level of engagement and interactivity not only motivates the students but also facilitates deeper comprehension and knowledge retention. AR gives the user an improved experience with wide exposure and access to additional or supplementary information (Daker and Jones, 2014). AR has the ability to bridge the gap between the physical and digital worlds to unlock a new dimension of learning possibilities, exposing students to actively participate in the learning process.

3. Improved Knowledge Retention

The traditional teaching methods often struggle to ensure long-term retention of information because the students struggle to connect abstract concepts to real-world applications. In technical/ vocational education, AR offers a promising solution to the challenge of knowledge retention. When students can see and interact with virtual object related to what they have learnt, they are more likely to retain that knowledge over time. Research by Maccarella, Liu, Gangadhara, Vincezi and Majiruns (2005) has shown that a combination of visual and auditory stimuli in AR significantly improved students' recall

when compared to the traditional teaching methods. In technical/ vocational education, through AR students will learn how to operate machines in the workshop to produce different type of articles.

4. Personalized Learning

AR allows for personalized learning experience that is tailored towards individual student's needs. AR can provide support and challenges through adopting content and interaction based on students' progress and abilities. Technical/ vocational education students can be assessed based on the skills they have acquired. According to Martins, Abdullahi, Agwi, Adeola and Lydia (2019), students can learn best through a social activity and participating in the social life of the school.

5. Real World Application

AR is able to bridge the gap between classroom learning and real-world application. In technical/ vocational education, AR enables students to connect theoretical knowledge to practical skills by overlaying virtual elements into real-world environments. Whether it's exploring wood design through virtual furniture making, AR provide students with authentic experiences to prepare for future careers and real-life challenges.

6. Accessibility and Inclusivity

In technical/ vocational education, AR promotes inclusivity by offering accessibility features and accommodating diverse needs of the learner. AR can provide audio cues, visual aids and multisensory feedback, supporting students with different learning abilities or disabilities. By removing physical barriers and providing alternative ways to interact with content, AR ensures that all students can actively participate and benefit from the learning experience. Students now have access to AR books, games, discovery-based learning applications, projects that model real-world object and projects exploring skill-based training (Yuen, Yaunyeyong and Johnson, 2011).

7. Global and Cultural Perspectives

AR exceeds geographical boundaries, offering student's access to global and cultural perspectives. Through virtual travel experience, language translation, interactive cultural exhibitions, AR allow students to explore different countries, traditions, and languages without leaving their classrooms. Students in technical/ vocational studies will have the potential to learn from the experiences of different countries in the world. These experiences will prepare the students to excel in a globalized world. Barata, Gana, Jorge and Goncalves, (2013) experimented virtual world software which combined Moodle World.

8. Gamification and Motivation

Gamification in learning is a simple gameplay to support productive interaction for special type of learners (Noor, Yusuf, Yussor and Ismail, 2015). In Technical/ vocational education, AR has the potential in making learning more enjoyable and encourage healthy competition among students, through incorporating game-like features such as challenge, rewards and progress tracking. In education, gamification through AR promotes intrinsic motivation since the students are driven by the desire to achieve goals or unlock new levels. AR game can increase motivation and can give positive impact to the cognitive process (Ferrer, Perdomo, Rasheed, Fies and Quarles, 2013). There are different AR games like GoGoBox, , GARLUS, Mentira, TimeWarp are in use.

Challenges of AR in Teaching Technical/ Vocational Skills The

challenges will be discussed under the following:

1. Individual Related Challenges

The individuals involved are teachers, students and developers. Being a new field of study, AR teachers have limited knowledge of the subject matter. The teachers also fear of failure of using the technology. There is the challenge of insufficient training, lack of equipment, limited class time and high cost of equipment. Generally, teachers have misconception of using AR tools to improve the academic achievement of the students (Cui Chan , Sun Lin & Lee, 2017).

The students face challenges during and after the use of AR. Students differ in their abilities and may have difficulties in connecting and observing while using AR technology (Radu, 2014). The student may lack sensory perception of AR-related experiments (Saidin, Halim and Yahaya, 2015). There is the challenge of cognitive overload when learning in AR environment, no content for practice, insufficient time for experiment, lack of proper guidance and lack of appropriate instructional scaffolds in AR application (Akcayr and Akcayr, 2017).

2. Challenges Related to Teaching using AR

The challenges related to teaching using AR includes lack exposure to teaching using AR, lack of teaching facilities, lack of experience in using AR in technical/ vocational education, unknown learning effectiveness and insufficient time for teaching are some of the challenges facing the teaching of AR (Huang and Lin, 2017). There is lack of information about AR for skill training in TVET (Hamid, Ismail & Yahaya, 2022).

3. System Development Related Challenge

Challenges related to system development includes: financial restrictions which makes it unaffordable for educational institutions to incorporate AR- related content in teaching and learning, limited capability, the need to develop applications to help motivate students, inadequate system design, lack of practical system content (Chang and Hwang, 2018 and Wu, Hwang, Yang & Chen, 2018).

4. Challenges Related to Usage of AR

In technical/vocational education, proper guideline for the implementation of AR is lacking. According to Hwang, Chen and Chou (2018), the issue of unfamiliarity with AR environment, occasional instability, cognitive overloading of the learners, users are not accustomed to using AR, lack of training of AR teachers as well as lack of available content for the practice of AR are some of the challenges related to usage of AR. Ayodeji and Adetunji, (2020) maintained that there is lack of fund and unwillingness to invest in AR which results in shortage of skilled personnel in technical/ vocational education.

5. Challenges Related to Environment

The challenges that are related to environment includes: difficulty of learning in an outdoor environment, the objects in the real and virtual worlds must be properly aligned with respect to each other or the illusion that the two worlds coexist will be compromised. The situational contents for the environment are also lacking (Wei, Weng, Liu and Wang, 2015).

How to Overcome the Challenges of AR

To overcome the challenges of using AR in teaching technical/ vocational education, educators and institutions may consider the following strategies:

1. AR relies heavily on user interface and experience. The user interface should be designed in such a way that it is easy to understand and navigate by the students.
2. The existing infrastructure should be assessed with a view to identify gaps that may hinder the integration process. Hardware and software should be upgraded and updated through working with IT professionals. Explore options for sharing devices among students to increase accessibility.
3. To overcome the challenge of experience, there should be training and development programmes for teachers to handle AR devices and applications software for effective teaching and learning. Teachers should draw from experts' experience to tackle significant AR challenges.
4. The challenge of AR risks. Designers and developers must conduct thorough user testing and reiterate their designs based on feedback.
5. AR developers must prioritise privacy and security in designing and implementing AR applications to protect user's right.
6. In order to overcome the problem of cost and affordability. There is the need to provide a pre-built AR platform with more affordable and user-friendly AR devices and applications for a wider audience. Look for low cost AR devices that can provide valuable educational experience.
7. AR teachers should monitor future development in AR field like the use of 5G, AI or Blockchain. Collaborate with researchers to generate evidence. Share success stories and best practices through attending conferences, publications and online platforms to advocate the integration of AR in teaching and learning technical/ vocational education.

Conclusion

Teaching in the 21st century is gradually moving from the traditional method to the application of technology via AR. AR being an upgraded version that extends the natural environment separates the user completely from the real world. In technical and vocational education, teachers will now explore the benefits of AR in the illustration of complex production processes in workshop. AR software will enable students to see examples of machines, tools and equipment with all the parts. By using AR, this can be done quickly, efficiently and at a reasonable cost. The students will be more engaged; knowledge will become personalized, interactive, and more accessible by bridging the gap between classroom learning and real world application.

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