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A Technology Acceptance Model for Augmented Reality in Fostering Student Performance in Schools: A Review

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ABSTRACT

Today, the rapid development in technology and the evolution of immersive learning applications has changed the educational methods and the way learners acquire knowledge in educational institutions. The aim of this study is to evaluate the acceptance of augmented reality (AR) through technology acceptance model (TAM) which in turn foster student performance. A review of literature shows that AR serves the learning process in a very different way than expected by allowing learners to use the best options for learning new things. Findings reveals that AR contribute to student performance through accepting this technology in a series of associations between perceived usefulness, perceived ease of use, attitude towards use, intention to use, which in turn foster student performance. This fact has compelled educational institutions such as schools to deploy AR for the benefit of students, teachers, and the entire educational system in any country. This paper shows that AR helps students grasp complex ideas and scientific disciplines, allows them to engage with the learning environment, and motivates them to continue studying. The constructs of TAM (perceived usefulness, perceived ease of use, attitude towards use, intention to use) contribute to student performance in classrooms that used AR as a supportive learning tool.

KEYWORDS: Augmented Reality, Technology Acceptance Model, Student Performance.

1 Introduction

Today, the fast advancement of technology and the creation of immersive learning apps have altered educational techniques and the way students gain information in educational institutions (Hirve & Reddy, 2022). Augmented Reality (AR) become one

the most effective tool to enhance learning in recent decade. AR provides a virtual interface in 3D that augments what a person sees by layering digital material over the actual world in a way that entirely immerse the user in the virtual world since the actual world is constantly visible (Elmqaddem, 2019). Researchers agree that AR is a novel technique to incorporate virtual reality into educational settings; it has been observed that using AR into learning courses improves student academic achievement (AlNajdi, 2022). In the future, AR will be a crucial technological contributor, facilitating a significant paradigm change in how students engage with scientific topics. In fact, inspiring students through AR application helps them attain their learning goals (Rahm et al., 2021). To that end, it is crucial to understand that motivation to learn by using AR is a key component of effective teaching (Asvio, 2022). In other sense, AR facilitates comprehension learning of complex and abstract subjects (Sun & Gao, 2020). In this regard, it is important to consider innovative teaching methods based on AR to assist schools ease learning and simplify complex courses like mathematics, chemistry, and physics (Filgona et al., 2020).

The United Arab Emirates (UAE) has witnessed a rapid growth in many industries, and the standard of life in the nation has been connected to global developments over the last several decades. In parallel with the significant development that entitle UAW among the pioneer developing countries, the ministry of education of UAE adopted a strategy that embrace cutting-edge technology for schools and promote innovation in learning methods used in classrooms. Within the framework of implementing the UAE's strategy and the framework of the UAE Centennial 2071, improving the educational process and learning methods in schools is set to be through creative and innovative learning environments (Krzymowski, 2020; Zarrouk et al., 2021), whereas the educational environment must keep pace with technological development in order to close the gap between the UAE and developed countries in the education domain. As a result, the purpose of this research is to apply the technology acceptance model (TAM) to an AR application for schools in the UAE, as well as to determine AR acceptability by users (students/teachers) and the influence of intention to use AR on student academic performance.

2 The Challenges of Learning

Teachers and students may struggle to adapt to a new way of learning and interacting with material through AR, especially if they are not given proper guidance or resources (Valladares et al., 2023; Kamińska et al., 2023). Oueida et al. (2023) reported that pupils may experience cognitive overload while studying. Without sufficient training and support, both instructors and students may be reluctant to fully embrace the potential advantages of augmented reality in the classroom. Another difficulty is technological limitations, since AR apps sometimes need particular resources, such as smartphones or tablets with superior camera capabilities, to work properly (John et al., 2022). Not all students or schools may have the necessary abilities to utilize AR applications, creating a digital gap in which certain students may be excluded from AR-enhanced learning experiences (Perifanou et al., 2022). Some professors report that pupils lose interest in the AR software because they utilize their smartphones for other purposes (Alalwan et al., 2020). AR should improve learning experiences rather

than just being a novelty. Furthermore, one of the primary problems that instructors have is understanding how to smoothly incorporate AR into their teaching approaches in order to generate relevant learning results (Perifanou et al., 2022). This study assumes that integrating AR activities with conventional teaching methods and ensuring that they are aligned with educational requirements might be difficult. While there is rising interest in AR as a tool for education, scientific proof of its usefulness in boosting learning outcomes remains limited. Schools may be cautious to invest in AR technology unless there is convincing proof of educational advantages. To address these difficulties, educators, technologists, legislators, and other stakeholders must work together to create accessible, inexpensive, and pedagogically sound augmented reality solutions for schools. Training programs, research projects, and governmental assistance may all contribute to a wider adoption of AR technology in education. According to a literature review, studying using AR can help pupils grasp content and become more creative students. In contrast, little study has been conducted on the acceptability of AR in an educational context. As a result, understanding the importance of AR adoption is critical for motivating students to embrace this revolutionary technology in education. This research used the Technology acceptability Model (TAM) to identify the characteristics that lead to AR acceptability. This model has widely used to evaluate how people accept new technology in many industries, e.g., Shen et al. (2022) explored the factors influencing the adoption and usage of AR applications in tourism education within the context of the COVID-19 pandemic, others found that the acceptance of dance training can be boosted using AR (Iqbal & Sidhu, 2022), while Ghobadi et al. (2022) assessed how AR Applications are being used in education and determined key factors affecting the Furthermore, TAM has been tested in AR-based university learning settings (López et al., 2019). However, in the UAE, the use of AR has yet to be studied and reviewed in secondary schools. As a result, this research represents a novel academic endeavor to explore these issues in UAE schools that have just used AR in their curricula. Based on these claims, it is necessary to examine students and teachers' acceptance to use AR as part of the curriculum in UAE schools before flowing a particular initiatives in adopting AR in a large scale in UAE educational system.

3 Literature Review

3.1 Augmented Reality

Augmented Reality (AR) is a technology that integrates 3D virtual items into a real-world 3D environment in real time, allowing users to interact with and supplement material. Digital augmentations of place will play an increasingly important part in daily, lived geographies as spatially connected information and the code that regulates it become more widely available (Graham et al., 2022). New tactics and technologies are constantly being developed in order to boost student engagement and learning outcomes. AR technology stands out among these tools because to its multiple advantages (Wang et al., 2018). AR is a technique that superimposes virtual items over a live picture of actual settings, enabling users to see how these objects fit into their surroundings (Tan et al., 2022). Sırakaya and Alsancak (2022) define augmented reality as the ability to overlay virtual elements on real-world photographs

simultaneously. As a consequence, virtual things seem in the same context as real-world objects (Turan et al., 2018). AR technology's availability and efficiency have increased in recent years for a wide range of purposes and applications (Kim et al., 2018). Using appropriate AR software, a user displays virtual or augmented objects overlaid on the actual world, which may be accessible via interfaces such as smart glasses, tablets, and smartphones (Paris et al., 2017). This allows people to move about any regular area and interact with virtual objects that may be enhanced with objectives, landmarks, and other information using computational methods (Shachar et al., 2019). Despite the fact that AR is still in its early stages of development, industry experts such as Apple CEO Tim Cook and Google's Director of Virtual Reality (VR) and AR, Greg Jones (Forbes, 2018), have complimented the technology's potential to transform the shopping experience. With the availability of AR toolkits from tech heavyweights Apple and Google, companies can now construct their own AR-enabled mobile applications. Facebook just released AR-enabled display ads in its News Feed, making the technology even more accessible to companies (Business Insider, 2019).

Researchers suggest that teaching in schools is more challenging than teaching at universities and colleges. School instructors must work hard to make substantial improvements in the usage of modern teaching techniques, which necessitates the creation of new teaching methods. To that end, AR provides new teaching techniques based on an immersive learning environment, which contributes to improved information acquisition in the modern day. The application of augmented reality in education is a significant research issue (Khan et al., 2019). AR integrates virtual items into real-world settings, creating an immersive learning environment with real-time interaction (Martín-Gutiérrez et al., 2015). The effectiveness of using AR technology in the educational process, the survival of the impact of learning, the increase in learners' motivation to learn, and the increased educational importance of this type of technology, especially with society's tendency towards technological development and visual culture, The many visual stimuli generated by AR technology, such as virtual pictures, animations, and video clips that mirror actual world, serve to capture the learner's attention and improve brain processes. By observing and distinguishing things, knowing their visual characteristics, and identifying the parts of the educational scene in order to discover their content and compare their components, one can achieve sound thinking and functional knowledge of applying learning in the workplace.

Furthermore, Altinpulluk (2019) stated that using AR in educational settings can (1) provide objects in a three-dimensional perspective; (2) enable collaborative and simultaneous learning; (3) improve cooperation among learners and learners with educators; (4) transform invisible objects into visible objects; (5) serve as a bridge between formal and informal learning; and (6) increase learners' interest, motivation, imagination, and creativity. However, AR has significant downsides, like as (1) sensitive to change, (2) having a limited number of designers, and (3) requiring a large amount of storage capacity on the installed equipment (Anggraini et al., 2020). AR technologies may help students achieve better learning outcomes while also enabling new forms of experiences for all learners. Immersive experiences have been shown to reduce cognitive load and distance, increase engagement, and improve memory recall for complex or abstract subjects like STEM (science, technology, engineering, and mathematics), which frequently rely on two-dimensional representations of otherwise

intangible concepts (Ibid., 2018). Individual-level immersive learning allows for more tailored methods that can fit a wide range of learning styles, speeds, and capacities (Eli, 2019). They may also give feedback to students and instructors, as well as adapt individual learning goals to meet students where they are, helping them to realize their full potential while leaving fewer behind.

3.2 Augmented Reality in Schools

AR has emerged as one of the fastest growing technical disciplines, and it has had a significant impact on the field of education in recent years. Because education is accessible to revolutionary technologies, AR delivers several advantages to students and has a significant impact on learning techniques by making studying simple and enjoyable. Today, developing countries are increasingly employing AR in schools and colleges or remotely, AR emerges as a significant aid for students learning complicated and abstract scientific concepts. The use of AR in schools has numerous benefits that have made it a key intervention in the area of education, since AR offers a wide range of capabilities that alter the conventional education process and allow students to modify their location and time of study. In other words, the greatest kind of education is one that instills a desire for knowledge while also making the educational process more enjoyable and vibrant by using new methods for learning such as AR, with a few conventional lectures and a lot of projects, readings, and reading in AR learning environment. With the rising use of contemporary technology in the educational process, the number of instructors who wish to educate their students in innovative methods has grown. The literature shows how AR contribute to student performance as well as teaching efficiency, while also enhancing and growing the educational process in order to reach the intended aim of education via AR.

The effectiveness of incorporating AR into the educational process is mostly determined by instructors' awareness and possession of the skills and knowledge necessary to utilize and interact with this technology, as well as their understanding of the idea of AR. Furthermore, AR allows students in school to engage in what is known as situational learning. The intended objective of AR is to supplement the actual world represented by the pages of the curriculum. This is accomplished by adding a new level of information to the real environment while utilizing the capabilities produced by the virtual digital environment, resulting in a curriculum that combines the strength of the text with the additional information produced by the virtual digital environment (Qeshta, 2018. In light of the above, Al-Anzi and Al-Felikawi (2018) affirm that AR is the best option to address the issues of conventional teaching techniques in schools that rely on picture memory via an immersive learning environment. Using AR in schools increases students' interest in learning, engages them in the educational process, and contributes to transforming learners' experiences from abstract to tangible by allowing students to watch three-dimensional videos, explanations, and images via AR. It would boost the learners' motivation and passion for the learning process, potentially leading them to meditate while studying and observing, which would significantly improve their mental and creative talents. It is clear that augmented reality significantly improves learning techniques in schools and simplifies the whole learning process.

In the same context, Al-Zein (2018) suggested an educational program to build AR design abilities among Jordanian university students, as well as an examination of the influence of AR on academic achievement. The need of teaching lecturers and students in the skills of developing AR in all courses, as well as encouraging faculty members, learners, and researchers to use the possibilities of augmented reality technology in the educational process. Similarly, Al-Anzi and Al-Failakawi (2018) assessed faculty members' familiarity of the idea of augmented reality at Kuwaiti colleges. The study's findings revealed a modest level of knowledge of AR among faculty members; thus, the researchers underlined the significance of teaching faculty members to employ AR in the learning process. In the same context. Mat-jizat et al. (2018) investigated the efficacy of AR as an educational technique in improving knowledge acquisition and desire to learn. They investigated the use of AR as a teaching and learning aid in secondary schools. Furthermore, they investigated the differences in learners' performance between AR, they found that using stimulation techniques to test students' capacity to use AR. They observed that when AR is used instead of conventional learning techniques, students' performance improves and their enthusiasm to learn increases.

Safar et al. (2017) investigated the efficacy of employing AR skills to teach the English alphabet to kindergarten students in Kuwait. The sample consisted of (42) learners who were separated into two groups: the control group, which included (21) learners, and the experimental group, which included 21 learners. Teachers employed before-and-after measurements to assess the usefulness of AR skills in improving learners' performance and academic accomplishment. The findings of their research revealed that instructors' use of creativity and innovation abilities, as well as the usage of AR, greatly boosts student performance and academic accomplishment. In addition, Table 2.1 summarize the findings of AR impact on schools in different countries around the world.

Table 3.1: A Summary of findings on AR role in schools

Authors	**Objectives**	**Findings**
Nasser et al., 2020	The objective of the study was how technologies such as augmented reality (AR) and virtual reality (VR) can be used to improve the learning and teaching of science makes it difficult for educational policy makers to apply additional measures in order to ensure the availability of equipment and trained staff.	The outcomes from this study can provide insights for administrators and policy makers to set priorities for using VR and AR in school practice to carry out various reflective and exploration tasks.
Hamiyet & Rabia, 2019	The aim of this study was to analyze the effect of AR applications on reading comprehension and learning permanency and to examine 5th grade students' attitudes towards AR applications.	The experimental group students showed a higher level of reading comprehension and learning permanency when measured on a weekly basis than the control group. AR applications can be used effectively as educational aids for reading-related courses.

Authors	Objectives	Findings
Mustafa & Hasan, 2020	The purpose of this study is to investigate the effect of AR, an instructional material for teaching magnetism using augmented reality and sensing technology, on students' academic achievement and learning process, and to identify students' views about augmented reality.	The results suggest that AR should not be considered as an independent learning environment for the teaching of physics, but would be more effective as supplementary to the laboratory environment.
Izwan et al., 2018	The advanced of the technology evolving currently enable the use of innovative learning tools for various fields especially in education. Different technologies have been implemented in the educational sector to enhance the method of teaching and learning.	This research gives a brief insight into the potential and challenge of Augmented Reality in education to enhance the method of teaching and learning from conventional to the technological by using the AR technology.
Muhammad et al., 2018	Educational media for students to understand 3D geometry is currently conventional, schools and teaching staff find it difficult to get teaching aids as educational media tools to build 3D space.	The results obtained are 3D geometry modeling successfully read the marker and if the3D AR model is clicked then a formula will appear from each geometry.
Seçil & Ercan, 2023	This research aims to reveal the effects of using augmented reality applications on seventh-grade secondary school students' academic achievement and motivation and to identify students' views on augmented reality applications.	The academic achievement and motivation of the students in the experimental group using augmented reality application were significantly higher than the students in the control group. Students thought that the augmented reality application helped them learn the subjects, facilitated the concretization of abstract concepts, and provided active learning experiences.
Yıldırım, 2021	The aim of this study was to determine the effectiveness of the Science teaching process to middle school students using teaching materials prepared via augmented reality (AR) technology.	As a result of the study, it was revealed that AR implementations contributed positively to students' science learning processes, and it increased their academic achievement.
Hidayat et al., 2021	This study presents a literature review on the use of Augmented Reality technology to students at the basic education level.	Students still have to consider the concept of the difference between the real world and the virtual world.
Veronica et al., 2020	Currently digital educational applications are employed in education, since technological tools are very interesting and engaging for pupils. Augmented	The results showed that Geo+ is effective in terms of student learning gain.

Authors	Objectives	Findings
	Reality (AR) is one of the most explored and successfully used technology.	
Eleni et al., 2020	Taking advantage of the ability of virtual and augmented reality to visualize 3D objects, we investigate the potential of using virtual and augmented reality technologies for teaching the lesson of geometric solids to primary school children.	The results indicate that the implementation of new technologies in education of virtual and augmented reality improve interactivity and student interest in mathematics education, contributing to more efficient learning and understanding of mathematical concepts when compared to traditional teaching methods.
Mona, 2017	this study reviews the main benefits of using augmented reality applications in education. It also aims to examine user acceptance of augmented reality applications within an e-learning environment in secondary schools, from the teachers' perspective, as an initial experiment	As a result of the explosion and rapid growth in information technologies that can be used in education, there are increasing demands to adopt technology in education, in order to influence students to learn actively and motivate them to gain an effective learning process.
Maria & Lilla, 2019	The main focus of this study is visualization in science and engineering education using augmented reality in the context of biology education based on constructivist and constructionist concepts.	The findings of the study confirmed, using this method, that the students' understanding was deeper, their motivation was greater, and, last but not least, their creativity was strongly supported.
Marie-Anne et al., 2019	This research examines the perspectives of AR using educators who are Innovators and First Adopters in Roger's Diffusion of Innovation Scale.	Results appear to show that educators were largely using downloadable AR apps, but found them highly engaging and enjoyable with students
Plamen & Tatiana, 2020	The objective of this research was to explore the impact of an AR tool on students' learning performance. The study has shown a substantial improvement in students' understanding of the matter studied.	This research shows that the AR technology, especially when used in STEM education, allows students to explore, practice and interact with STEM content without worrying about financial or ethical issues, such as costly consumables or animal injury.
Ni & Gusti, 2020	This research aims to design geometrical mathematics learning media especially cubes and blocks based on Augmented Reality technology for fifth-grade elementary school students and to know the level of product worthiness from the subject and validator.	It was concluded that the application of elementary geometrical mathematics learning media based on Augmented Reality technology can be used in secondary schools as a medium for learning mathematics.

Authors	Objectives	Findings
Haifa et al., 2018	This paper contributes to answering the questions of what are the design features of the collaborative AR that can be embedded in a school textbook, and also of how co-design with and for children can be applied in the context of AR.	Using cooperative inquiry techniques as an appropriate method of co-design with children, this paper proposes the key design features that can be integrated in the school textbook for a collaborative AR textbook.
Ibáñez et al., 2019	The authors designed an augmented reality application for students to practice the basic principles of geometry, and a similar application which encompasses identical learning objectives and content deployed in a Web-based learning environment.	The research findings imply that in Mexico, augmented reality technology can be exploited as an effective learning environment for helping middle-school students from public and private schools to practice the basic principles of Geometry.
Vasyl & Olesia, 2020	Objectives of the study was to analyze the experience of using AR technologies in education, also to find out the possibilities of using augmented reality technology in teaching computer science, and to experimentally test the attitude and readiness of teachers to use AR in teaching of computer science.	The results of this study show that IT teachers have access to computers and mobile devices and have a high level of interest in augmented reality technology.
Liliia et al., 2020	The objective of the research is development a mobile application (on the Android platform) designed for visualization of the Solar System with the AR technology and the alphabet study, applying the astronomic definitions, which can be used by the teacher and the students for an effective training for studying the subjects of the astronomic cycle in primary school.	Studying the alphabet in the offered mobile app will definitely help nail the achieved knowledge and get interesting information about celestial bodies that are invisible and superior for kids; to make a journey into the space, prepare a project on "The Space Mysteries" subject; to stimulate the development of curiosity, cognitive motivation and learning activity; the development of imagination, creative initiative, including speaking out.
Liliia et al., 2020	The purpose of the research is creation of mobile app (supported by Android) for visualization of chemical structure of water and to display video data of laboratory experiments that can be used by the teacher and pupils for an effective background for learning natural cycle subjects and performance of laboratory experiments in the elementary school using lapbook.	As a result of work, aimed at visualizing the education material, a free mobile app LiCo.STEM was developed; it can be downloaded from the overall-available resource Google Play Market. Representation of the developed video materials on the mobile gadgets is conducted by "binding" them to individual images-"markers" for every laboratory experiment.
Rohendi et al., 2018	In this research, we developed geometry learning media based on augmented	The results of this study showed that the use of geometry learning media

Authors	Objectives	Findings
	reality in android flatform's then it was implemented in teaching three dimensional objects for some junior high school students to find out: how is the student's response in using this new media in geometry and is this media can solve the student's difficulties in understanding geometry concept.	based on augmented reality in android flatform is able to get positive responses from the students in learning geometry concepts especially three-dimensional objects and students easier to understand concept of diagonal in geometry than before using this media.
Pellas et al., 2017	This review aims to lay the groundwork for educators, technology developers, and other stakeholders involved in the development of literacy programs for students and children by offering new insights with effective advice and suggestions on how to increase student motivation and improve learning outcomes and the learning experience by incorporating ARGBL into their teaching.	The main findings from this review provide the current state of the art research in augmented reality with game-based learning (ARGBL) in compulsory education. Trends and the vision towards the future are also discussed, as ARGBL can potentially influence the students' attendance, knowledge transfer, skill acquisition, hands-on digital experience, and positive attitude towards their learning.

A survey of the literature demonstrates that consecutive improvements in learning techniques in the contemporary period have imposed an urgent need to improve the effectiveness of school instructors in adopting novel learning technologies such as AR. To stay up with the information age and become successful instructors under the AR, they must develop unique technical abilities, create technical material, and train on these skills in both cognitive and skilled areas. Scholars on this issue have emphasized the need of training programs that prepare instructors to utilize AR in their classrooms. In short, AR learning has become crucial in today's classrooms. This is supported by several research that have examined the use of augmented reality in the educational curriculum. Modern schools must incorporate AR-based technological innovation into the classroom to demonstrate AR's remarkable effectiveness in transitioning from a single-source environment to an interactive and immersive learning environment, as well as from a resource-poor environment to a resource-rich environment. Therefore, the present research attempted to investigate the reality of adopting AR technology from the perspective of secondary school teachers in their schools.

3.3 Student academic performance

Student academic performance refers to the academic achievements and accomplishments shown by students in a variety of educational contexts. It includes a variety of characteristics such as grades, test scores, class participation, attendance, and general involvement in learning activities. However, the definition and meaning of student academic achievement differ depending on the context and viewpoint from which it is evaluated. For example, some writers may describe student academic achievement only in terms of quantitative metrics such as test scores and grades, but others may incorporate qualitative qualities such as critical thinking abilities and creativity. Evaluating student performance is based on the use of innovative

technologies such as augmented reality is crucial for various reasons (Webster et al., 2020).

Individual students' academic performance might vary depending on their particular strengths and limitations, which contribute to their total academic success (Vignery, 2022). Finally, assessing and evaluating student academic success necessitates taking into account a wide range of criteria in order to acquire a full view of their educational accomplishments (Kumar, 2019). This might include things like class engagement, attendance, and extracurricular activities. It is critical to remember that student academic achievement is determined not only by numerical metrics, but also by the acquisition of necessary life skills and the capacity to apply information in real-world settings. Taking a comprehensive approach to measuring student academic achievement allows educators and administrators to better help students in realizing their full potential and prepare them for future success (Bowden et al., 2021).

AR has become a valuable tool in current classrooms, particularly for secondary education (Marín-Díaz et al., 2022). AR is transforming how students' learning and interact with instructional information (Fitria, 2023). It is evident that AR technology improves the learning experience by overlaying digital information on the actual environment, making it more interactive, immersive, and customized. As a consequence, incorporating AR into the classroom may have a major impact on student academic achievement. AR allows pupils to perceive complicated concepts in 3D, making it easier to absorb abstract notions (Yang et al., 2023). This hands-on approach promotes a better grasp and retention of information. Furthermore, AR allows educators to adjust courses to unique learning styles and paces, guaranteeing that every student gets a personalized education (Sharma, 2022). AR promotes active engagement and critical thinking by instilling curiosity and creativity (Demircioglu et al., 2022), which leads to enhanced academic performance and student achievement in STEM programs (Alkhabra et al., 2023). For example, in a biology lesson, students may utilize augmented reality (AR) to explore the human body in 3D, zooming in and rotating organs to better comprehend their roles and interactions. This immersive experience not only helps students visualize complex concepts such as the circulatory system, but it also allows them to interact with virtual models, improving their understanding of complex and abstract subjects. It has also been reported that AR-based argumentation activities in science classes can help students develop critical thinking skills and argumentation abilities (Demircioglu et al., 2022).

The above ideas and data demonstrate that researching the impact of AR on student academic performance should give evidence on how AR might improve the educational process in schools. AR may deliver tailored quizzes and evaluations depending on each student's progress, enabling instructors to tailor the lesson plan and provide focused help to individual students. By introducing AR technology into the classroom, educators may accommodate to diverse learning styles while also providing a more engaging and dynamic learning experience that significantly improves students' critical thinking (Lin & Yu, 2023). All of these elements contribute to student academic success. AR may help bridge the gap between theory and practice by imitating real-world circumstances and enabling students to apply their knowledge in a virtual setting.

Overall, the application of augmented reality in education has the potential to transform the way students learn and increase their knowledge of complicated concepts. Based on the above ideas, researching the effect of AR in schools is critical for a variety of reasons. For starters, AR has the ability to transform the way students class offering immersive and engaging experiences. It enables students to visualize complicated ideas, participate in hands-on activities, and get a deeper grasp of numerous topics. Furthermore, researching AR's impact in schools may assist discover areas for further research and development, resulting in ongoing progress and innovation in educational technology. To that end, researching the function of AR in education may assist educators in determining the most effective methods to incorporate this technology into the classroom, ensuring that it improves learning outcomes and increases student engagement. By researching AR's role in schools, we can address any potential challenges or limitations associated with implementing this technology, particularly in UAE secondary schools, such as the cost of acquiring and maintaining the necessary equipment, the availability of appropriate AR content and applications, and the need for teacher training and support. Understanding these obstacles would allow teachers and administrators in UAE schools to make educated choices about using AR in the classroom, ensuring that technology is utilized successfully and efficiently to assist student learning.

4 The AR-TAM framework

The arguments in this study show that TAM is a strong acceptance theory that has been used in research on the acceptability of many forms of information technology (Kim & Shin, 2015). The TAM has been used to explain the acceptance of wearable devices (Chuah et al., 2016; Yang et al., 2016; Kim & Shin, 2015), intelligent health monitoring systems (Tseng et al., 2013), business intelligence systems (Wang, 2016), smart in-store technology (Kim et al., 2017), and intelligent tourism (Venkatesh & Davis, 2000). This model has been recognized as one of the most widely used theoretical models for explaining why a user accepts or rejects a given technology and how an organization anticipates user behavior (Venkatesh, 2000; Legris et al., 2003). External variables are the primary component of TAM, which has been updated to form various versions of this model, whereas the original constructs included in the majority of studies associated with technology acceptance, such as perceived usefulness, perceived ease of use, attitude, intention to use, and actual use, comprise the original TAM. External factors, according to TAM, have a direct impact on perceived utility and perceived ease of use, the two cognitive belief components. Perceived ease of use has a direct impact on attitude, but perceived usefulness impacts attitude and behavioral intention to use, which in turn influences actual usage. Furthermore, external variables that appeared in three or more studies were identified as the most often used external factors in the broader notion of widening TAM throughout the technological adoption process.

According to Emad et al. (2016), external influences have been thoroughly explored when expanding TAM ideas to various corners of the globe in the health care industry. A comprehensive evaluation of 23 publications published over a four-year period (2015-2018) revealed and assessed 56 external variables. Only five of the 56 external

variables assumed to be extensively utilized in boosting technology adoption across user groups were widely used. Management, operations, organizational, strategy, and information technology infrastructure (Wangpipatwong et al., 2008; Who, 2011; Emad et al., 2016). In this research, the external variable is the virtual class's resources. TAM has limitations when employed outside of the workplace since it ignores the social effect on technology adoption. The majority of studies expand TAM in line with the study objectives. Lee et al. (2020) investigated the elements influencing the desire to use AR speakers and created and expanded the technology acceptance model (E-TAM). They added anthropomorphism, service variety, simplicity of use, and perceived privacy invasion as independent factors to be able to explain adequately by applying an expanded TAM to the goal of AR speakers, which are now gaining attention as a next-generation platform. In addition, a model with perceived utility and felt pleasure as parameters was developed.

The extended TAM incorporates additional parameters into TAM to increase its flexibility, explanatory power, and specificity (Maillet et al. 2015). In this research, virtual classroom materials serve as external variables that influence the performance of students who utilize augmented reality throughout their learning. Extending TAM is advocated and should be considered in the educational sector. Some external factors must be added in TAM to generate a more consistent forecast of system utilization (Taherdoost et al., 2009; Taherdoost and Masrom, 2009). TAM's importance in understanding the behavior of users (students) while utilizing a certain technology is not only to execute tasks, but also to fulfill the social requirements of students who use it. According to Marangunić and Granić (2015), TAM is based on personal perceptions about perceived utility and simplicity of use. However, these two constructs are acknowledged as TAM pillars and may be modified by external factors such as virtual classroom resources, while the attitude toward embracing and integrating the desired technology is determined by perceived utility and simplicity of use. Figure-1 shows the suggested AR-based TAM model for AR-Based classrooms in UAE schools.

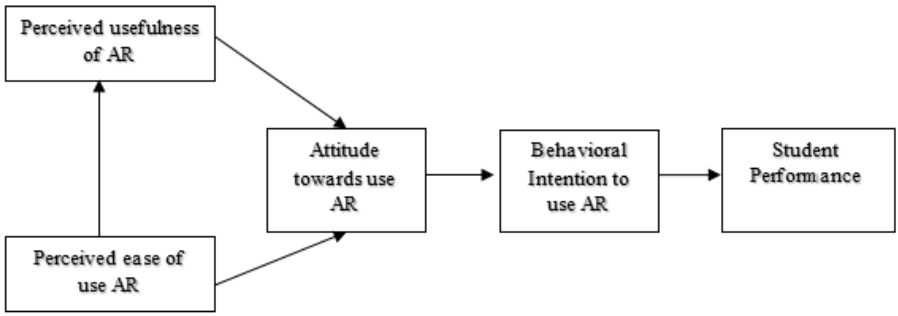

Figure-1: An AR-based TAM model in Classrooms.

As TAM has been reported a highly effective theory in describing why a user (i.e., student or teacher) has an intention and a favorable attitude to utilize a new technology like AR (Mokha & Kumar, 2021), as well as users' perceptions (Susilo et al., 2021; Masimba & Zuva, 2021). This study evaluated students and teachers' acceptance to

use AR by deploying TAM model for this purpose. To that aim, the TAM framework gives useful insights into the elements that drive AR user acceptability and adoption, offering light on why students are so eager to embrace this novel technology. Based on these considerations, this research concluded that TAM is an appropriate model for investigating variables that impact AR adoption in schools (Billanes & Enevoldsen, 2021). Hence, further analysis on students and teachers' acceptance to use AR in classroom will provide a valuable insight on the following variables of TAM that explain how AR is accepted in education and the learning process.

i. Perceived Ease of Use

According to Davis et al. (1989) perceived ease of use (PEU) is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). The perceived ease of use (PEU) of any given system is defined as the level of technology employed with the perception of proper application of the prescribed technology. In Tam framework, the perceived ease of use has a direct or indirect association with perceived usefulness (Alloghani et al., 2015; To & Trinh, 2021). In other words, the PEU is specifically related to the perceptions of technology (Phatthana & Mat, 2011).

ii. Perceived Usefulness

Perceived usefulness (PU), defined by Davis et al. (1989) as "the subjective perception of users where they believe that using certain technologies can improve the performance of their work". In other words, PU refers to the level at which users expect new technology to enhance the work and their performance (Alharbi & Drew, 2014), and it is the metric by which AR improves the learning ability (Alloghani et al., 2015; To & Trinh, 2021). Furthermore, the PU reflects the perceptions of user to the system and how far the system will be useful for them (Emad et al., 2016).

iii. Attitude Toward Use

According to Davis et al. (1989) "the attitude of an individual is not the only factor that determines his use of a system, but is also based on the impact which it may have on his performance". In other words, Attitude Toward Use (ATU) is the degree to which people have favorable or negative feelings toward an object or event, and it is strongly related to behavioral intention to use (Malik & Al-Emran, 2018).

iv. Behavioral Intention to Use

Davis et al. (1989) defined Behavioral Intention to Use (PIU) as "the degree to which an individual believes that using a particular system would be free of effort". In AR setting, BIU is the willingness of the students to use AR applications which is influenced by ATU as well as BIU affect the actual user of the system (Fayad & Paper, 2015; Cao et al., 2021). Several studies have also found that BIU has a direct and significant impact on the real-world implementation of AR in service organizations (Helia et al., 2018). Moreover, researchers have found that the behavioral intention to use AR technology has a significant impact on student academic performance which is reflected on their academic achievements (Santos et al., 2013; Cabero-Almenara et al., 2019; Álvarez-Marín et al., 2020; Masa'deh et al., 2022).

5 Conclusions

The review of literature shows that AR contribute to student performance through accepting this technology in a series of associations between perceived usefulness, perceived ease of use, attitude towards use, intention to use, which in turn foster student performance. The current age is experiencing significant advancements in numerous domains of knowledge and research. The new educational approaches must move away from existing systems and toward a new horizon via AR applications. The challenges of technological advancements forced educational institutions such as schools to work continuously on modernizing their educational systems, moving away from old traditional methods that are no longer sufficient for learning in the era of the Internet and the computer, and searching for new methods that add value to the learning process while keeping up with the development and progress in information technology and educational innovations. AR creates an interactive learning environment that piques the interest of researchers in the education field and inspires academics to investigate the influence of AR on student performance. There is a need to provide a framework that explains how students see AR as a whole new manner of learning. Many studies have shown that using AR technology in education helps to strengthen learners' capacity to create, invent, and cultivate creative talents, thus improving academic accomplishment. In other words, augmented reality has shown to be the finest learning approach available today for encouraging inventive thinking and improving academic performance. Based on the debates and arguments in this chapter, this study suggests that AR serves the learning process in a very different way than expected; it allows learners to use the best options for learning new things. This fact has compelled educational institutions such as schools to deploy AR for the benefit of students, teachers, and the entire educational system in any country. It helps students grasp complex ideas and scientific disciplines, allows them to engage with the learning environment, and motivates them to continue studying.

6 References

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