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AIAVRT: 5.0 Transformation in Medical Education with Next Generation AI- 3D Animation and VR Integrated Computer Graphics Imagery

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ABSTRACT

Immersive recreations of actual classrooms in virtual reality (VR) provide students and teachers with insights into the classroom. Recent technological advances in haptics, display systems, and motion detection create a realistic and interactive experience, making VR ideal for hands-on training. The main fields of application for VR are interventional procedures like surgeries. VR devices allow teachers to quickly identify and address difficulties in the clever learning for complicated surgery course. With this in mind, it stands to reason that students will do better in logical thinking in a virtual classroom. Augmented reality (AR) enables users to project virtual information and structures over physical objects, enhancing or changing the real world. It is very beneficial to incorporate AR applications in understanding anatomical structures and physiological mechanisms. Many scholars have attempted to demonstrate the validity and educational impact of various VR and AR applications on different hardware platforms. Some even proposed a curriculum that incorporates these methods. This article aims to assist universities in maintaining and improving their education and learning systems through the use of a VR-based e-learning platform. Machine learning (ML) and artificial intelligence (AI) were employed to assess the learning impact of VR in medical education. In addition, the authors predicted student performance through multiple validation tests, such as the T-Test, P-Test, and One-Sample Validation test, and analyzed the proposed model with different parameters.

1. INTRODUCTION

In the booming medical industry, the most recent advancements are the use of virtual reality (VR) and augmented reality (AR) for teaching and learning. VR refers to the virtual creation of a computer-generated world, so that the user is entirely immersed in the virtual environment. In this world, the user can feel the realism of the virtual structures, and interact with those structures. However, high-performance computers are needed to transmit and process all this information with near-zero latency. This has only recently become available, thanks to the technological development of cutting-edge haptic devices with force-feedback capabilities (bidirectional stimuli), high-resolution audio-visual effects, and motion detection technology, to name but a few.

In 1965, Robert Mann built the first virtual medical system to improve the environment for resident training of orthopedic surgery. Wearable head-mounted displays (HMDs) for medical VR applications initially debuted in the late 1980s. As another important real-world application of VR, the virtual classroom eliminates the concerns and difficulties connected with regular classrooms, and helps students to focus entirely on their studies. In this study, a well-suited e-learning platform is employed to motivate the effective learning by students.

In the virtual classroom, teachers and students interact like in a real classroom [1]. The word interact here means face-to-face contact. The virtual classroom enables students to interact with teachers online, learn by VR and many other techniques, view video lectures of other teachers quickly, search any related topic at any time, and ask questions from anywhere. There is no time limit for research in the virtual classroom. If a student has a membership (Classroom Login ID and password), he/she can log in from anywhere, such as home, office, and cybercafé. In online classes, the learner wastes no time in going to the learning institutes, which are sometimes far from home. The virtual classroom brings all the learning materials to his/her doorstep, provided that the learner has an Internet connection on their smart gadgets. In the virtual classroom, the teacher's task is to direct the students through different learning styles, and solve in-class problems. There is no need to worry about the skipped lessons or studied materials. If a learner skips a lecture or reading for some reason or leave the class, he/she will be registered in the classroom database [2, 3]. In addition, the virtual classroom

offers very exciting live teaching and group discussion. The virtual classroom consists of live chat, audios and videos, video conferencing, live presentation, instant subject reporting and reviews, a whiteboard for teachers and students, and smart homework assignments. With the aid of ML and AI, the virtual learning system can upgrade automatically from previous experience, store vast amounts of data, and extract repeatedly learned or similar data.

The future of higher education hinges on the evolution of new technologies and the computing power of new smart machines. India is blessed with several good schools and colleges. But most of Indian students do not enter the next level of education for various reasons. Some of them face an economic problem, some fail to recognize the importance of next level of education, and some simply do not have good teachers in the region [4]. Therefore, this study proposes an approach to climate students based on the higher education level.

VR and AR require specific hardware to achieve good simulation. Three-dimensional (3D) images and sounds generated by computers must be realistic, emulating actual, abstract structures. The user movements should be precisely recognized to adjust the visual field (size, shape, and angle of objects) and auditory stimuli (volume, sound balance) accordingly. Besides, the user must be able to both influence and be influenced by haptic feedback stimuli. To satisfy these demands for haptic interaction, specialized haptic devices are often employed, including joysticks and gloves. Moreover, high-performance computers are needed to process the massive volume of information with minimal, undetectable latency. All of these contribute to the primary feature of VR and AR: an immersive environment. Furthermore, a fast and dependable Internet connection is essential to most recent VR developments in the industry. Without that, it is impossible to construct VR for a place where users meet and engage with each other online, in a shared virtual world.

When it comes to medical education, operating rooms are sometimes too small for students to see and learn about surgery. In most cases, only 2-3 students are present in the operating room at any given time. Of course, the presence of more students in the operating room increases the patient's risk of infection. Medical technology is distinguished by multidisciplinary teams and complex decision-making. As a result, medical professionals and students are required to continue their education, in order to tackle new challenges, and to respond properly to the patient's needs. Fortunately, robotics and VR can now be used in close proximity to each other in the setting of medical treatment. These emerging techniques could be combined with conventional tools like mannequins [5] to train the skills of medical students.

VR/AR tools for education appear to have high levels of construct and prediction validity, with most students able to apply their newfound knowledge in the real world. While many of studies have been conducted in the relevant fields, some of them may have questionable legitimacy. To begin with, many scholars did not carry out a randomized controlled trial, as they used a small set of samples with varying features. Also, the simulators were not explored sufficiently, and not built to the same standards, making it difficult to synthesize and compare. Many studies that make simulator-specific references ignore that those simulators are always being improved. More randomized controlled trails are needed to compare the efficacy of VR training to that of no training, other types of simulation-based training, or alternative VR training systems. In addition, it is important to clarify how much the ability of users deteriorates with time. Once these factors are elucidated, we may investigate how VR and AR might be formally included into medical education programs.

This article aims to assist universities in maintaining and improving their education and learning systems through the use of a VR-based e-learning platform. Machine learning (ML) and artificial intelligence (AI) were employed to assess the learning impact of VR in medical education. In addition, the authors predicted student performance through multiple validation tests, such as the T-Test, P-Test, and One-Sample Validation test, and analyzed the proposed model with different parameters.

2. LITERATURE REVIEW

Head-mounted displays (HMDs) are commonplace in VR applications. A head-mounted display (HMD) is a display that supports immersive visualization of a simulated environment, while blocking out any external visual stimuli. The original HMDs could only display images of 800×600 pixels, and had a field of view (FOV) of 30°. In contrast, modern HMDs can display images in full high definition and have an FOV of up to 360°. Some wireless modern HMDs are embedded with positioning and detection systems for eye and head movements. Despite their importance in many VR environments, HMDs are not required for all medical applications. Many procedures, including laparoscopic and endoscopic surgeries, need a computer screen to display virtual images.

Network technology enables virtual classrooms, in which students and teachers interact via an online interface [6]. Considering the importance of career choice to a student, exceptional cultural practitioners adopted questionnaire surveys to identify critical impactors of learning performance. However, it is difficult to predict the course of work, given the complex goals and dreams of each student. Recent research has shown that student data based on behavioral features provide a good basis for workflow forecast. Hence, a revolutionary model was created and implemented to forecast student decisions, namely, ACCBOX (Approach Cluster Centers Based On XGBOOST). Experimental results show that the model outperforms all previous prediction algorithms.

In India, only 0.3% of the population advances from postgraduate to research level education. Focusing on student achievement through various reasoning, Walter et al. [7] divided students into low, middle, and high achievement groups, and combined support vector machine (SVM) with k-means clustering (KMC) to make the above architects accountable. The SVM was adopted for classification, and the KMC was used to assemble student data. The student performance was predicted on a range of tests, using data mining principles. The prediction program utilizes semantic rules and SVM concepts. The semantic limitations increase the quality of educational contents and facilitate the transmission of educational activity to all students. Their approach was found to benefit both low and high achievement students, and enhance their desire in continued learning. In this way, Walter enhanced the overall quality of learning by predicting their level of education and student assistance before they begin their studies.

Some scholars demonstrated the relationship between the level of primary education profile and the end level of

education profile of Federal Polytechnic students. The O-level was defined as the first academic profile in the system of classification. The grade point average (GPA) was used to evaluate student achievement in courses (Grade R). Using data mining techniques, the authors intended to develop a new model for forecasting student performance in the future. The files were preprocessed to eliminate data redundancy. The idea of SVM was drawn to predict the success of students, and compared with the other ML ideas, such as line break, KNN, and decision tree. The SVM was proved to be more accurate than other ML concepts.

With the advancement of technology, virtual classes become much more accessible, particularly in social sciences [8]. It is increasingly important to predict the success of students in higher education institutions. This would help with the detection and improvement of student performance in various subjects. Many elements should be considered to enhance performance. The notion of clustering is often adopted to improve the quality of an enhancement learning program by separating students into groups. The Ada-boost genetically modified approach, often known as Ada-GA, were adopted by Militello et al. [8] to enhance the performance of dividers. This approach was utilized to assess the students' risk level against a huge amount of collected data. The outcome provides teachers with a good reference for giving counselling to depressed students.

Liu [9] employed various tools and approaches in the virtual classroom, including video conferencing systems [9], and a multimedia environment that incorporates a whiteboard and text chat, among others. The students are accessible to many types of learning and teaching resources, including e-mail, YouTube, and wikis, while others make use of learning management systems (LMS). The market of virtual classroom grows, as new settings with more features begin to appear. In addition to sound and visual quality, the market focuses primarily on the overall implementation and usability of the environment. Interactive classrooms are originally utilized to benefit distance learners and mixed learning environments, as well as to supplement on-campus courses. In the virtual classroom, distant learners and instructors could interact actively to improve student engagement, inspire and encourage individuals, and assist students in developing a learning community while avoiding alienation. Group assignments in the virtual classroom enhance the students' design skills, learning ability, motivation, and capacity, and help them understand more about themselves.

ML aims to investigate and invent algorithms that learn and anticipate the experimental outcomes. The University of Southern California has created an artificial gadget that includes avatar-based training modules, which could transfer military personnel to other locations for military training.

2.1 Impact of VR on classroom

2.1.1 Time efficiency

Traditional classrooms have a time limit. Sometimes, there is not enough time for the teacher to answer the questions raised by a student. In the virtual classroom, however, any student from anywhere can ask questions 24/7. There is no need to sit in the classroom and listen to lectures. The students only need to log in to the classroom server, pick the module, and choose subjects and teachers. Hence, every learner can better understand the topics with the aid of classroom resources [10].

2.1.2 Enhanced understanding and better learning ability

The virtual classroom provides many functions that develop student skills, making learning relatively easy. Students can access their classroom accounts, and learn from anywhere, anytime. The only requirements are classroom ID and Internet connection. Experienced teachers manage the class sessions in an online classroom, while the students communicate easily with the teachers. The teachers are offered innovative methods to connect with the students.

2.1.3 Accurate feedbacks and rating

At the end of the semester, the virtual classroom provides a feedback form to the students at school or colleges. Traditionally, the feedback process is a formality without much value. In the virtual classroom, however, hand-to-hand feedback is sent to students after each class, and a feedback report is issued on a daily basis [11]. The accurate feedback improves the skills and learning styles of both teachers and students. The virtual classroom provides a rating system. After each session, the teacher is rated by the AI technology. At the end of each month, the teacher with the highest rating will be observable openly.

2.1.4 ML and AI in virtual classroom

ML is a computer science based on AI. Most ML systems learn from their previous work, or gain knowledge of the prior work. As its name suggests, AI is both artificial and intelligent. Artificial means the replication is true to the original, and intelligent refers to the consistency between concepts and ideas, which facilitates user comprehensive. Instead of a machine, a tool, or a computing program, AI is applied in structures or devices. Using AI, a system can work insightfully to execute its tasks. AI can complete the jobs that can be done by humans effortlessly in the computer field [12].

On an intelligent learning platform, ML can easily handle scoring and grading tasks. Take the intellectual learning environment for example. Optical recognition, an AI technology, can be utilized in the grading system to complete grading with innovative assessments. The technology enables the teachers to optimize the efficiency of classroom teaching, and tailor the teaching to individual students.

Currently, ML and AI are being used to quickly review and rate written tasks, such as essays. Teachers can also store important college files and student scores in the cloud. All data must be preserved securely. Some cloud storages provide free reposition of up to 5 GB of data for new members [13].

In short, AI is any field in which the computer works intelligently. It derives from the human model. In virtual schools, the various cultural backgrounds and language abilities of students are fully considered. With the help of AI and natural language processing (NLP), the text files are interpreted manually, and subtitles of video files appear in the language that the user is familiar with.

3. METHODOLOGY

This paper carries out virtual experiments on 3D human-computer interaction, realistic images, and 3D sound positioning technologies, and derives the roadmap of VR testing (Figure 1).

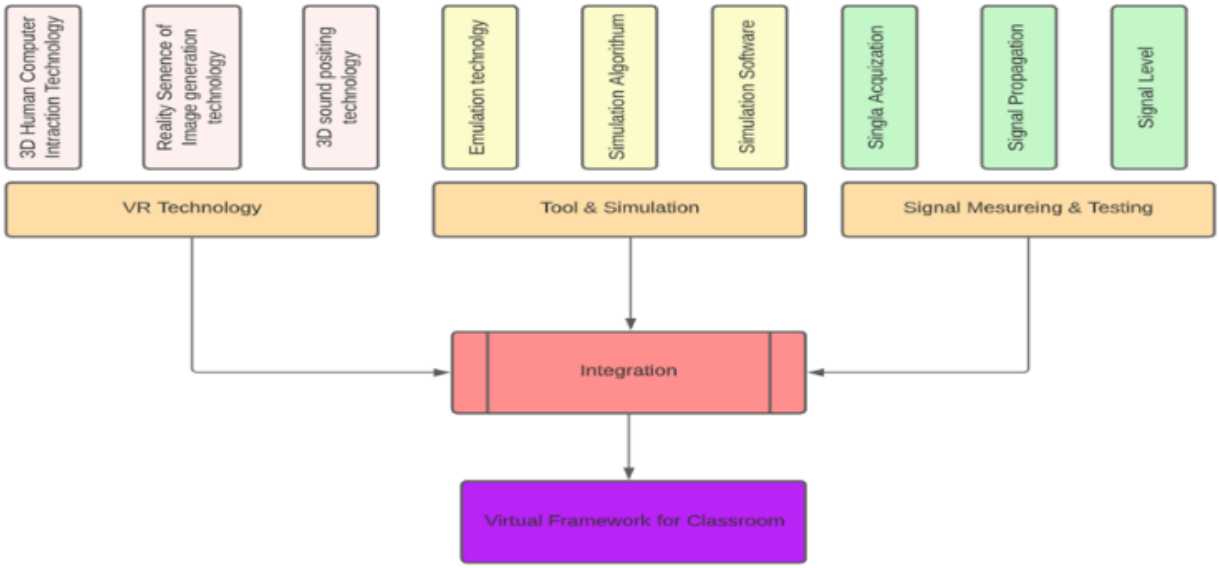

Figure 1. Propose d model for immersive learning

Firstly, the BL_M member classifier set of students engaging in the virtual classroom was evaluated, and the closest neighbor confidence for virtual classroom participation was appraised:

$$H_M = \{BL_1, BL_2, \ldots, BL_{M-1} \mid BL_M \in H\}. \quad (1)$$

where, H_M is a different classifier from BL_M. The following must be satisfied in order to classify non-sporting athletes:
We focused on the students from different colleges, who attended PE classes. These students are likely to be similar in classification [14].

If the above condition permits, the trust in unmarked student may be estimated. X_M and X_N, two students of PE class, had a cosine similarity score of 0.

$$S(X_M, X_N) = \frac{X_M \cdot X_M}{\|X_M\|\|X_N\|}. \quad (2)$$

The training set L_M of the BL_M member classifier includes the unclassified students, and the classifier H_M can draw attention to this group [15]. The consistency of k, $\text{Conf}(x_i)$ of x and its neighbor at this moment can be calculated as a certain sort of confidence:

$$\text{Conf}(x_i^u) = \sum_{\substack{q=1 \\ q \neq m}}^{M-1} \sum_{j}^{k} S(x_i^u, x_j^l) \times \text{consistency}\left(BL_q(x_i^u), y_{x_j'}\right). \quad (3)$$

Among them,

$$\text{consistency}\left(BL_q(x_i^u), y_{x_j^j}\right) = \begin{cases} -1, BL_M(x_i^u) = y_{x_j^l} \\ 1, BL_M(x_i^u) = y_{x_j^l} \end{cases}, (x_j^l) \in \varphi_i^l. \quad (4)$$

The score x_i^u can be derived from the member classifier set H_M:

$$y_u = \arg\min_{1 \le c \le C} H_m(x_u). \quad (5)$$

Based on VR, the proposed framework for PE virtual classroom presents a new approach to PE. The implementation of the approach was built on a framework for semi-supervised training. The selection strategy based on Q statistics was employed to choose the most appropriate VR technology.

4. EXPERIMENTAL ANALYSIS

Our experiments involve a total of 597 qualified students, who had shared their view on the use of VR in classroom teaching. The authors developed a VR teaching and learning platform, including MS Kinect. The training pitch simulation was created using MS HoloLens, HTC Vive Kit Pro, and Oculus Rift, Autodesk MAYA, and Unreal Game Engine. The data were collected using the VR simulator to identify user position, attention, and quick response, and to communicate the results to the VR devices wirelessly. Figure 2 illustrates the user activity and experiential learning in our model.

Table 1 summarizes the feedbacks of the students on different ML methods.

For the test group in the real operational environment [16], it is necessary to disassemble and reassemble the reducer assembly model with the aid of the data and tools, and to conduct a knowledge research and test based on the experimental results [17]. As shown in Table 2, the test group and the control group had not significant difference. The test devices and texts had an equivalent correlation with observed functions.

Virtual 2D texts and 3D videos exemplify how the learning materials of the AR education apps could be accessed from anywhere, and how the two types of data could be seen from any location.

Table 1. Feedbacks on ML methods

	Frequency	Percentage	Valid Percent	Cumulative Percent
Female	155	26.0	26.0	26.0
Male	441	73.9	73.9	99.8
Other	1	.2	.2	100.0

Table 2. Statical analysis on VR effect on online education

Attributes	N	Mean	Std. Deviation	Std. Error Mean
AR learning materials are accessible anytime, anywhere.	587	3.57	.882	.036
AR education app does not require any special device, and is easy to access.	587	3.37	.624	.026
AR education app makes learning engaging, interesting, interactive, and gamified, and significantly improves student learning.	587	4.23	.466	.019
AR education app enhances collaboration and improves interactive lessons, where all students are involved in the learning process.	587	4.59	.691	.029
AR education app facilitates practical learning in off-class hours.	587	4.37	.636	.026
AR helps to maintain long-term attention on a particular item or topic.	587	4.22	.504	.021
AR education app enables students to understand theoretical knowledge, as well as the subject.	587	4.35	.658	.027
AR education app makes the way of learning more attentive than traditional methods.	587	4.22	.510	.021
AR education app visualizes the subject, and brings better results through the immersive environment.	587	4.30	.511	.021
AR education app makes full use of AR in schooling/college/professional training.	587	4.42	.555	.023
AR education app forges the practical understanding of the concepts.	587	3.96	.752	.031
AR education app is universally applicable to any level of education and training.	587	4.21	.500	.021
AR education app applies to a complete curriculum, and supplements current pedagogical materials.	587	4.16	.843	.035
AR education app offers vast opportunities to diversify and shape up boring classes.	587	4.22	.508	.021
AR education app makes classes interactive, and enhances the confidence of learners.	587	4.48	.573	.024
AR education app allows students to learn after class, outside the classroom.	587	4.67	.539	.022
AR education app gamifies the concepts, such that students can understand them quickly.	587	4.90	.455	.019
AR education app presents the concepts more clearly than traditional learning programs.	587	4.27	.564	.023
AR education app provides new opportunities for students to learn how to communicate and collaborate.	587	4.45	.597	.025
AR education app is relatively affordable, and accommodates with mobile devices.	587	4.63	.605	.025
AR education app ensures the training safety of students.	587	4.02	.779	.032
Are you get satisfied with AR education app?	587	4.47	.590	.024
We have completed the lesson successfully using the app, and are satisfied with it.	587	4.47	.593	.024
AR education app motivates students in learning, and improves academic activities.	587	4.65	.582	.024
I enjoyed learning through the AR education app.	587	4.03	.705	.029
AR education app saves the time for repeated explanations.	587	4.20	.531	.022
AR education app helps us to learn the practical skills beyond the classroom.	587	4.21	.524	.022
Students are comfortable working with the components of 3D graphics/AR apps.	587	4.21	.529	.022
AR renders objects that are hard to imagine and turns them into 3D models, making them easier to master.	587	4.23	.487	.020
AR animation facilitates learning, brings our attention to the subject, and motivates us to study.	587	4.24	.486	.020

Figure 2. User activity and experiential learning in our model

Independent sample t-test was adopted to analyse all data completed in SPSS software. Suppose the P-value of significance is greater than 0.05 in Levene's test for equality of variances. This means VR boosts student happiness, because of its high devotion. Student satisfaction with their education experience is directly correlated to the qualities of their teachers. Thus, instructor quality stands as an extremely important factor to consider [18]. VR is crucial to the smoothness of course teaching, and enables students to do better academically. In the presence of VR, students become happier, and the learning process is improved. Students are more likely to be satisfied, if the instructor takes the time to get to know them and their needs, with the aid of VR. Thus, it was concluded that the quality of the teacher has a major impact on student satisfaction (Table 3).

During the analysis of test data, three conditions were considered as errors: a single error, a single record, and several mistakes [19]. The failure of depositing parts in the designated tray is noted as a task error.

Table 3. Results of independent sample t-test

Attributes	T Value	Df	Significance		Mean difference	95% Confidence interval of the difference	
			One-Sided p	Two-Sided p		Lower	Upper
AR learning materials are accessible anytime, anywhere.	97.967	586	.000	.000	3.567	3.50	3.64
AR education app does not require any special device, and is easy to access.	130.680	586	.000	.000	3.366	3.32	3.42
AR education app makes learning engaging, interesting, interactive, and gamified, and significantly improves student learning.	219.699	586	.000	.000	4.228	4.19	4.27
AR education app enhances collaboration and improves interactive lessons, where all students are involved in the learning process.	160.956	586	.000	.000	4.591	4.54	4.65
AR education app facilitates practical learning in off-class hours.	166.524	586	.000	.000	4.371	4.32	4.42
AR helps to maintain long-term attention on a particular item or topic.	202.989	586	.000	.000	4.220	4.18	4.26
AR education app enables students to understand theoretical knowledge, as well as the subject.	160.177	586	.000	.000	4.353	4.30	4.41
AR education app makes the way of learning more attentive than traditional methods.	200.774	586	.000	.000	4.225	4.18	4.27
AR education app visualizes the subject, and brings better results through the immersive environment.	203.913	586	.000	.000	4.298	4.26	4.34
AR education app makes full use of AR in schooling/college/professional training.	192.709	586	.000	.000	4.417	4.37	4.46
AR education app forges the practical understanding of the concepts.	127.626	586	.000	.000	3.959	3.90	4.02
AR education app is universally applicable to any level of education and training.	204.226	586	.000	.000	4.213	4.17	4.25
AR education app applies to a complete curriculum, and supplements current pedagogical materials.	119.540	586	.000	.000	4.158	4.09	4.23
AR education app offers vast opportunities to diversify and shape up boring classes.	200.893	586	.000	.000	4.216	4.18	4.26
AR education app makes classes interactive, and enhances the confidence of learners.	189.332	586	.000	.000	4.479	4.43	4.53
AR education app allows students to learn after class, outside the classroom.	209.833	586	.000	.000	4.668	4.62	4.71
AR education app gamifies the concepts, such that students can understand them quickly.	260.912	586	.000	.000	4.903	4.87	4.94
AR education app presents the concepts more clearly than traditional learning programs.	183.179	586	.000	.000	4.266	4.22	4.31
AR education app provides new opportunities for students to learn how to communicate and collaborate.	180.358	586	.000	.000	4.446	4.40	4.49
AR education app is relatively affordable, and accommodates with mobile devices.	185.484	586	.000	.000	4.632	4.58	4.68
AR education app ensures the training safety of students.	124.897	586	.000	.000	4.017	3.95	4.08
Are you get satisfied with AR education app?	183.458	586	.000	.000	4.470	4.42	4.52
We have completed the lesson successfully using the app, and are satisfied with it.	182.482	586	.000	.000	4.467	4.42	4.51
AR education app motivates students in learning, and improves academic activities.	193.490	586	.000	.000	4.646	4.60	4.69
I enjoyed learning through the AR education app.	138.328	586	.000	.000	4.027	3.97	4.08
AR education app saves the time for repeated explanations.	191.698	586	.000	.000	4.204	4.16	4.25
AR education app helps us to learn the practical skills beyond the classroom.	194.713	586	.000	.000	4.208	4.17	4.25
Students are comfortable working with the components of 3D graphics/AR apps.	192.598	586	.000	.000	4.206	4.16	4.25
AR renders objects that are hard to imagine and turns them into 3D models, making them easier to master.	210.576	586	.000	.000	4.233	4.19	4.27
AR animation facilitates learning, brings our attention to the subject, and motivates us to study.	211.146	586	.000	.000	4.239	4.20	4.28

In this study, six variables (categories) were identified through the exploratory investigation [20]. For the first category, the following statements were explored: the teacher communicated well; the instruction is passionate about VR application in online education; the instructor is concerned about student learning.

For the second category, the following statements were explored: the course is organized using VR; the course design allows assignments to be completed in various learning contexts; the teacher guided the course well.

For the third category, the following statements were explored: The teacher answered swiftly to my inquiries

concerning the usage of Webinar; the instructor reacted promptly to my queries about the general requirements of the course.

In the category of student expectations, the following statements were explored: The teacher gave models that clearly express expectations for weekly group tasks; the instructor uses good examples to illustrate statistical concepts…

Table 4. T-test results analysis

Attributes	Test Value = 0						
	T Value	Df	Significance		Mean difference	95% Confidence interval of the difference	
			One-Sided p	Two-Sided p		Lower	Upper
AR learning materials are accessible anytime, anywhere.	97.967	586	.000	.000	3.567	97.967	586
AR education app does not require any special device, and is easy to access.	130.680	586	.000	.000	3.366	130.680	586
AR education app makes learning engaging, interesting, interactive, and gamified, and significantly improves student learning.	219.699	586	.000	.000	4.228	219.699	586
AR education app enhances collaboration and improves interactive lessons, where all students are involved in the learning process.	160.956	586	.000	.000	4.591	160.956	586
AR education app facilitates practical learning in off-class hours.	166.524	586	.000	.000	4.371	166.524	586
AR helps to maintain long-term attention on a particular item or topic.	202.989	586	.000	.000	4.220	202.989	586
AR education app enables students to understand theoretical knowledge, as well as the subject.	160.177	586	.000	.000	4.353	160.177	586
AR education app makes the way of learning more attentive than traditional methods.	200.774	586	.000	.000	4.225	200.774	586
AR education app visualizes the subject, and brings better results through the immersive environment.	203.913	586	.000	.000	4.298	203.913	586
AR education app makes full use of AR in schooling/college/professional training.	192.709	586	.000	.000	4.417	192.709	586
AR education app forges the practical understanding of the concepts.	127.626	586	.000	.000	3.959	127.626	586
AR education app is universally applicable to any level of education and training.	204.226	586	.000	.000	4.213	204.226	586
AR education app applies to a complete curriculum, and supplements current pedagogical materials.	119.540	586	.000	.000	4.158	119.540	586
AR education app offers vast opportunities to diversify and shape up boring classes.	200.893	586	.000	.000	4.216	200.893	586
AR education app makes classes interactive, and enhances the confidence of learners.	189.332	586	.000	.000	4.479	189.332	586
AR education app allows students to learn after class, outside the classroom.	209.833	586	.000	.000	4.668	209.833	586
AR education app gamifies the concepts, such that students can understand them quickly.	260.912	586	.000	.000	4.903	260.912	586
AR education app presents the concepts more clearly than traditional learning programs.	183.179	586	.000	.000	4.266	183.179	586
AR education app provides new opportunities for students to learn how to communicate and collaborate.	180.358	586	.000	.000	4.446	180.358	586
AR education app is relatively affordable, and accommodates with mobile devices.	185.484	586	.000	.000	4.632	185.484	586
AR education app ensures the training safety of students.	124.897	586	.000	.000	4.017	124.897	586
Are you get satisfied with AR education app?	183.458	586	.000	.000	4.470	183.458	586
We have completed the lesson successfully using the app, and are satisfied with it.	182.482	586	.000	.000	4.467	182.482	586
AR education app motivates students in learning, and improves academic activities.	193.490	586	.000	.000	4.646	193.490	586
I enjoyed learning through the AR education app.	138.328	586	.000	.000	4.027	138.328	586
AR education app saves the time for repeated explanations.	191.698	586	.000	.000	4.204	191.698	586
AR education app helps us to learn the practical skills beyond the classroom.	194.713	586	.000	.000	4.208	194.713	586
Students are comfortable working with the components of 3D graphics/AR apps.	192.598	586	.000	.000	4.206	192.598	586
AR renders objects that are hard to imagine and turns them into 3D models, making them easier to master.	210.576	586	.000	.000	4.233	210.576	586
AR animation facilitates learning, brings our attention to the subject, and motivates us to study.	211.146	586	.000	.000	4.239	211.146	586

Table 5. Model summary and parameter estimates

Model Summary and Parameter Estimates							
Dependent Variable: AR Education app learning materials are accessible at any time anywhere							
	Equation						Equation
Equation	R Square	F	df1	df2	Sig.	Constant	b1
Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic
Compound	Compound	Compound	Compound	Compound	Compound	Compound	Compound
S	S	S	S	S	S	S	S
Growth	Growth	Growth	Growth	Growth	Growth	Growth	Growth
Exponential	Exponential	Exponential	Exponential	Exponential	Exponential	Exponentia	Exponential

When it comes to the category of student happiness, the following comments were noticed: The online classes were beneficial; Overall, I am delighted with the quality of this course… [21].

For the last category, the following statements were explored: The online classes have polished my analytic abilities; online classes genuinely attempt to get the best out of all students…

69.8% of the total variation was explained by these six variables [22].

4.1 One sample test

VR is frequently adopted to enhance the classroom experience in the traditional education system. To distinguish novel items in VR is known as novelty recognition [23]. Object identification is a common task among animals. If a mouse is placed in two comparable environments for 5min, one of the environments would be changed to include a new or unique item. It is expected that the mouse would spend more time examining the unknown object. Since mice are inherently interested, the percentage of time spent examining the novel object compared to a familiar object can be calculated by:

Time Spent for identifying the Familiar Object using Virtual

$$\text{Reality} = \frac{\text{Time Spent Investigating}}{\text{Time Spent Investigating} + \text{Novel Object}} \times 100 \quad (6)$$

If a student spends the same amount of time exploring each object [24], the outcome would be 50% using the same formula. Thus, the null hypothesis for this test was compared to the standard of 50%. A score below 50% suggests that the students recognized the novel object, but preferred the familiar one to the novel one. This might be associated with the human inclination for familiarity. Our goal is to judge whether the mean sample score varies substantially from the predicted value of 90%, using the four-step hypothesis test, which is discussed in the preceding section. That is, the goal is to determine whether the population mean varies from that of the sample mean:

H0: The mean percentage of time spent examining the novel item is 90%, as predicted by chance, when students are given the option to explore a novel and familiar object in the virtual classroom [25].

H1: If a student is given the option to explore a novel and a well-known object, the novel object often receives a smaller share of his/her attention.

Table 4 demonstrates the correlations between teacher quality, feedback timeliness, course design, student expectation, student happiness, and student performance. The first four factors had a positive correlation between them. The student happiness in online classes is positively correlated with the quality of the teacher (SE = 0.706, t-value = 24.196; p 0.05) [26], which validates H0. The course design exhibited a positive correlation with student satisfaction (SE = 0.064, t-value = 2.395; the correlation is statistically significant), which backs up H1 [27]. In addition, feedback timeliness promotes student happiness in online courses (SE = 0.067, t-value = 2.520; p=0.05), which also supports H1. Finally, student expectation has a positive correlated with student happiness (SE = 0.149, t-value = 5.127; p = 0.05) [28]. Thus, H1 was found to be correct.

The semi-supervised training approach suggested in the article was contrasted with the supervised training, with different features and feature combinations [29, 30]. As shown in Table 5, the proposed approach met all three criteria given here.

5. CONCLUSIONS

VR has been proved as a technique that boosts the teaching effect and student's subjective learning. Based on VR, the virtual classroom allows students to learn and exchange ideas, keep in contact over breaks, and work on group projects together. It is open to visitors (including professors, students, and researchers) from all over the world. Those who wish to study aboard would find the virtual classroom as a great resource, which helps them save time and money, without sacrificing the quality of education.

The VR-based virtual classroom provides quality instructions and a well-thought-out learning strategy. It has been employed to support digital teaching. Our work refines and repairs the flaws of the virtual classroom model with the help of VR and AI, which promote the learning by novice trainees. It is reasonable to conclude that our approach enhances the technical capabilities and learning abilities of students.

In future work, the addition of olfactory stimuli is a possible future development. Apart from their diagnostic value, odors have the potential to be utilized to more accurately to simulate dangerous or stressful situations (like a battle or an operation). Furthermore, the research of medical informatics is another potential research angle. VR and AR could be utilized to improve the visualization of medical data, provide intuitive statistical graphs and reports, and realize 4D interactions. To realize more realistic settings, we need stronger processing power, higher resolution, better scenario design, and improved haptic devices.

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