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Investigation on Contribution of AR and VR Involved in Remote Education

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Abstract

With their immersive and engaging experiences, augmented reality (AR) and virtual reality (VR) have developed into powerful tools that have the potential to completely change the educational landscape. The influence of virtual reality (VR) and augmented reality (AR) in education is reviewed in this paper, with an emphasis on new research and analytical applications that show how these technologies might improve learning outcomes and experiences. The capacity of virtual reality (VR) to produce captivating and immersive learning experiences demonstrates its influence in education. Better information retention, increased student engagement, and the growth of useful skills are the outcomes. AR, on the other hand, enhances conventional teaching resources by superimposing digital data onto the physical world. In order to give students an immersive and engaging learning experience while exploring pendulum dynamics, this paper details the design and creation of a Virtual Reality (VR) simulation for a basic pendulum physics experiment. The goal is to develop a virtual reality-based physics experiment simulation allowing users to perform a simple pendulum experiment by selecting different string lengths, initiating oscillation, timing the motion, and analysing results and. enhance conceptual understanding of pendulum motion and improve experimental skills in a virtual, risk-free environment. Preliminary user testing demonstrates the tool's potential to complement traditional laboratory experiments and support remote learning. Additionally, we offer a case study on the creation of a Virtual Physics Laboratory and suggest an architecture and development process for Virtual Laboratory applications.

Keywords: Virtual Reality (VR), Simple Pendulum, Augmented Reality (AR).

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1 Introduction

Physics is a foundational subject that propels scientific advancement and discovery by assisting students in understanding the natural world through measurements, experiments, mathematical modelling, and observations. Physics students may find it challenging to understand complex topics and become disengaged from traditional lecture-based teaching techniques. To improve student learning and retention, more immersive and participatory methods could be required(Qadeer, 2025). Furthermore, these approaches don't give pupils enough chances to use critical thinking to solve problems. E-learning is predominantly described as a technique for facilitating and enriching learning through the utilization of personal computers, CDROMs, and the Internet. Moreover, E-learning can bolster remote learning via Wide Area Networks (WANs), and it can also be recognized as a form of flexible learning (Jain & Chatterjee, 2024). Online learning is just one component of e-learning, which includes learning via the internet, intranet, and extranet, according to Urdan and Weggen. They highlight that the sophistication of online learning varies, ranging from rudimentary online learning programs comprising course materials and visuals, to comprehensive programs featuring activities, assessments, and meticulous record-keeping, such as test outcomes and bookmarks (Gao et al., 2021). It is commonly recognized that scientific research involves a dialectic process that oscillates between theory and experiment, often involving a numerical simulation of phenomena as an intermediary stage. However, reproducing this entire process in the classroom is challenging. Specifically, some educators believe that the numerical simulation can replace the laboratory experiment. This could be deceptive because simulation and experiment are completely different (Arvinth, 2023). While the results of real tests are primarily governed by physical phenomena, even when the experimental setup (often inspired by the model present in the researcher's head) plays a significant role, the results of simulations are entirely determined by the underlying modulization. Because of the advent of multimedia and the World Wide Web, the computer industry has seen tremendous change in recent years.

With immersive, interactive experiences that improve engagement, comprehension, and retention and provide new avenues for learning and exploring difficult subjects, virtual reality (VR) and augmented reality (AR) have the potential to revolutionize education (Sathish Kumar et al., 2024). The business provides engaging and immersive experiences that could enhance and include students in the educational process (Guo et al., 2021). Because of its potential to improve learning outcomes, increase engagement, and offer interactive experiences that benefit both teachers and students, augmented reality (AR) and virtual reality (VR) are becoming more and more popular in the educational field. E-learning, according to Hall and Snider, is the process of learning through computers that are linked to the Internet and intranets. According to these authors, e-learning is synonymous with web-based training, online training, dispersed learning, and technology-assisted learning (Hawthorne & Fontaine, 2024). It is anticipated that anticipated advancements in technology (such as PDAs and cellular phones) and channels (such as satellite and wireless) would broaden their reach to encompass a variety of new technologies and channels. E-learning encompasses a range of learning components, such as courses, modules, and smaller learning units. It accommodates both synchronous and asynchronous access and can be delivered across distances with different time constraints (Rangel-de Lazaro & Duart, 2023). Based on current research, the analysis assesses these technologies' usability, engagement, immersion, and educational outcomes and talks about the advantages and disadvantages of each platform for learning (Bakari, 2018). For instance, in the realm of surgical practice, when surgeons employ advanced miniature camera technology to perform laparoscopic surgeries remotely, their students can observe the procedures from any corner of the globe (Al Balushi et al., 2024). Professions characterized by continuous expansion and technological innovation are well-poised to furnish successful e-learning materials, tools, and settings that are rich in technology and results-oriented. There are several ways to depict and explain mathematical and scientific ideas and relationships, ranging from presenting Fermat's Theorem to fractal geometry. Whether through animations, modelling, or simulations, these tools can enhance learning experiences and establish connections between theoretical knowledge and practical application.

1.1. Opportunities and Challenges

By enhancing the connection between teachers and students, as well as motivation and communication, virtual reality (VR) and augmented reality (AR) are presently being utilized to enhance learning environments and unlock the educational potential of students. Through the provision of immersive and interactive experiences that boost student engagement, understanding, and retention, AR and VR positively influence learning effectiveness and ultimately the quality of the educational system. By developing immersive, interactive courses and virtual field trips accessible from any location, educators can enhance student engagement and learning through the application of AR and VR. By engaging in activities within virtual environments and receiving immediate feedback on their performance, AR and VR facilitate immersive learning experiences that enhance students' knowledge and skills. Furthermore, the incorporation of AR and VR in educational settings can render education more affordable and accessible for all by minimizing travel and instructional equipment costs. Educators can maximize their students' potential by employing these tools to deliver courses in a manner that is significantly more engaging and effective.

2 Related Work

Augmented Reality (AR) can act as a significant enhancement to collaborative activities in e-learning environments. There is an opportunity to develop and utilize innovative computer interfaces that effectively merge the physical and virtual worlds. This integration promises to improve both in-person and remote interactions and collaborations. Furthermore, this technology enables a smooth transition between the real world and virtual settings, which is a vital component in the academic context. Reference (Shen & Tan, 2023) highlights that interactions and collaborations enabled by AR closely mimic natural face-to-face interactions, distinguishing them from collaborations that occur solely on screens. AR is characterized as "enjoyable," "user-friendly," and "beneficial." These findings bear implications for student motivation, engagement, and the overall effectiveness of e-learning. Further reinforcing these insights, studies conducted by (Bahrami & Abdolvand, 2018) bolster the idea that augmented reality's integration into academic contexts has the potential to heighten student motivation and engagement. This effect is especially pronounced when incorporating game-based approaches, as highlighted in this comprehensive literature review, the foundation of visual education is made up of tools like computers, smart boards, and tablets, which facilitate quicker learning and memorability than the conventional technique. (Crompton & Burke, 2023) indicated that the rapid advancement of science and technology, in conjunction with advancements in both hardware and software, can significantly lower prices for both developers and users. Drawing on the attributes of AR technology and child psychology, this research's author conducted a feasibility analysis on employing AR in early childhood education. (Munir et al., 2022) introduced an application that employs augmented reality to navigate the campus. This app employs object recognition and computer vision to layer information about the campus environment and objects, resulting in a more captivating user experience. To enhance object recognition capabilities, the researcher in this study devised a virtual landscape modelling interface involving deep learning.

AR facilitates the merging of real-world visuals with virtual elements, producing realistic outcomes through overcoming intricate computer vision challenges. These challenges find effective solutions through robust implementations of deep learning. (Tureniyazova & Sprishevskiy, 2023)Achieving cutting-edge results in such applications necessitates the training of deep convolutional neural networks on large datasets. Observations were made of students utilizing either an Augmented Reality (AR) map via a mobile device, which presented AR data on a paper map, or a digital map that depended on GPS location for navigation within a neighborhood (Ikedinachi et al., 2019). The findings indicated that student collaboration within the AR group demonstrated greater levels of success. In contrast to students who utilized a GPS mapping program, those employing the AR application were able to create a shared platform, which facilitated effective collaboration among team members and the development of common interpretations. A study was conducted to compare gesture usage across different conditions: Augmented Reality (AR) and face-to-face settings, along with a projector-based condition where fewer deictic gestures were noted (Kaouni et al., 2023). This research explores how individuals collaborate while tackling spatial problems under various conditions, including head-mounted AR, projector-based AR, and non-AR environments. Individuals are positioned facing one another while collaborating in similar situations, which likely accounts for this observed effect (Alam, 2022). The utilization of technology to introduce novel virtual elements into the user's surroundings, thereby enhancing and enriching the experience, is referred to as Augmented Reality (AR). This term encompasses the enhancement of the user's physical environment through the incorporation of virtual components. Research is being done by many researchers to provide solutions for augmented reality that will increase its effectiveness, user-friendliness, efficiency, and social relevance.

The use of third-person point of view in traditional multimedia applications is a limitation. Users are not seen as active participants in the system. Instead, they are viewed as external (elements) agents who interact with the system indirectly, usually through verbal or symbolic means. This might easily discourage users from using the application, which would prevent instructional goals from being met. The restricted involvement can be partially attributed to the third-person point of view method. Despite being significantly better than text-based programs, traditional multimedia applications only allow for mouse operations or instructions, which are typically used for navigation.

3 Material and Method

To develop a virtual reality (VR) simulation of a simple pendulum experiment, you'll need to create a 3D environment with a virtual pendulum, allow users to adjust the string length, initiate oscillations, and record the time period. The simulation should also provide data analysis tools to visualize and analyse the pendulum's motion. To be more precise, we require further information regarding the many scientific fields. Enhancing students' comprehension of construction details through a progressive, experiential learning method was the intervention's main educational goal. The distinctive combination of concrete, steel, and wood, as well as the concrete's "peel-up" rise and curvature, make these benches perfect for teaching specific building aspects in landscape architecture, particularly the combination of various materials (such as concrete and wood). This component gave students' learning and creative discovery a concrete focus. In order to contrast traditional and technologically sophisticated educational paradigms, the course was designed to lead students from traditional learning methods to a new, co-created VR exhibition area.

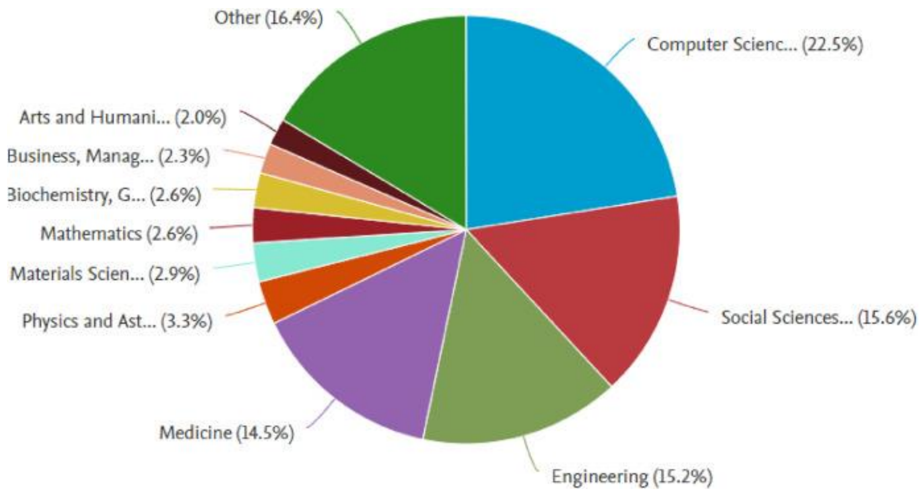

Figure 1: Documents based on Subject Area

The various scientific disciplines that included VR and AR in their curricula were shown in Figure 1. This study emphasizes the potential of virtual and augmented reality to improve learning outcomes and experiences by concentrating on its use in education. Computer science, social sciences, engineering, and medical were the professions that used VR and AR technologies the most frequently. Along with notes, letters, editorials, and brief surveys, other settings were used to improve the effectiveness of the research cycle. These comprised the language (English only), the source type (conference proceeding, 852, journals, 648, and book series, 283), the document kind and the year of publication (2011–2022). Following the completion of the aforementioned settings, 1536 documents served as the subject of this study and were utilized for additional analysis. The distribution of documents pertaining to VR and AR in education over the previous 12 years is depicted in Fig. 1.

3.1. Documents Analysis

Between 2011 and 2022, 527 articles from different Scopus-based journals discussed AR and VR in the classroom. 84 papers were selected using a single criterion to improve the analysis's accuracy and viability: the document had to be limited to articles and use both AR and VR in social science instruction. These 84 documents were uploaded to WordStat application for further analysis. The outcome included word-cloud, keyword distribution, word frequency and topic analysis. WordStat's ability to effectively analyze word frequency and term distribution gave researchers important insights into the data, thus they used it for content analysis.

Table 1: Illustrates this Analysis

No.	Topic	Coherence (NPMI)	Eigenvalue	FREQ.	Case
1	Infrastructure	0.626	4.11	787	83
2	Media & Content Knowledge	0.502	3.89	297	83
3	Teachers & students	0.381	2.51	115	55
8	Evaluations	0.465	2.40	449	85
9	Texting Mining	0.368	2.37	164	75
10	Augmented Reality	0.211	2.33	1195	83
11	Mobile Learning	0242	2.19	279	70
12	Online Learning	0.370	2.15	364	70
13	VR Technologies	0.403	2.13	673	83

With AR, VR, Augmented, Virtual, and technology among the top 10 terms with high frequencies, these data demonstrate the concentration of study over the past decade when compared to other learning fields. The final step in the analytical process is the topic analysis. Table 1: Thirteen of the twenty most popular themes in the analysis settings were chosen based on their serial numbers after being modified to meet our requirements.

3.2 Simple Pendulum Experiment

One complete cycle, consisting of left and right swings, is the duration of the period. A mass 'm' is suspended from a stable base using a thin, elastic string of length 'L'. Gravitational force initiates the motion in the vertical plane. In the case of a simple pendulum, the bob follows Simple Harmonic Motion (SHM), with the acceleration being a function of its displacement from the central position, which is always attracting it. The time period (T) of a simple pendulum for oscillations of small amplitude, is given by the relation:

$$\boldsymbol{T = \pi \sqrt{\frac{L}{g}}} \qquad (\mathbf{1})$$

The effective length (L) of the pendulum and the magnitude of the acceleration caused by gravity (g) govern its motion. The p-value, R^2, and regression line. Figure 8 shows the linear regressions' relative slopes, which are 4.044, 4.035, 4.045, 4.044, and 4.070.

$$4\pi^2 \left(1 + \frac{1}{16}\theta^2 + \frac{11}{3072}\theta^2 + \frac{173}{73728}\theta^2 + \cdots \right) \qquad (2)$$

With a latitude of 8.8297614 and a height of 20 meters, Sensors ONE (2021) was used to determine the actual gravity acceleration (g) for Nakhon Si Thammarat province, producing a result of 9.781. The relative error equation was used to determine the precision of the experimental value (9.806) in relation to the correct value (9.781), and the result was a relative error of 0.256%:

$$Error(\%) = \left|\frac{9781 - g_{exp}}{9.781}\right| \times 100 \qquad (3)$$

Our findings corroborate those of other researchers who computed the gravitational acceleration (g) in various locations using a basic pendulum motion experiment set. A curvilinear motion's velocity is defined.

$$v = \frac{d_r}{d_t} \qquad (4)$$

where the location vector is denoted by r. The tangent to the trajectory indicates the direction of the velocity v.

3.3 Development of the AR Experiences for the Simple Pendulum

A simple pendulum application using AR technology is developed with the help of unity. 3D models are used in pendulum motion experiments. With the assistance of AR, the complexities and difficulties in learning about a simple pendulum are minimized. The use of AR in illustrating the workings of a simple pendulum makes it simpler for students to grasp the underlying concepts. An info page is presented in the application which will help the students to use this App. Once the ground plane has been located, hit the square indicator on the display. Simple pendulum experiments will be augmented on the detected plane. The simple pendulum concept can be grasped by students through the utilization of the lab setup found in the science lab. Students can experience the principles of a simple pendulum through Augmented Reality, making it possible for them to learn from home. These concepts became clearer to students as they engaged with the AR system.

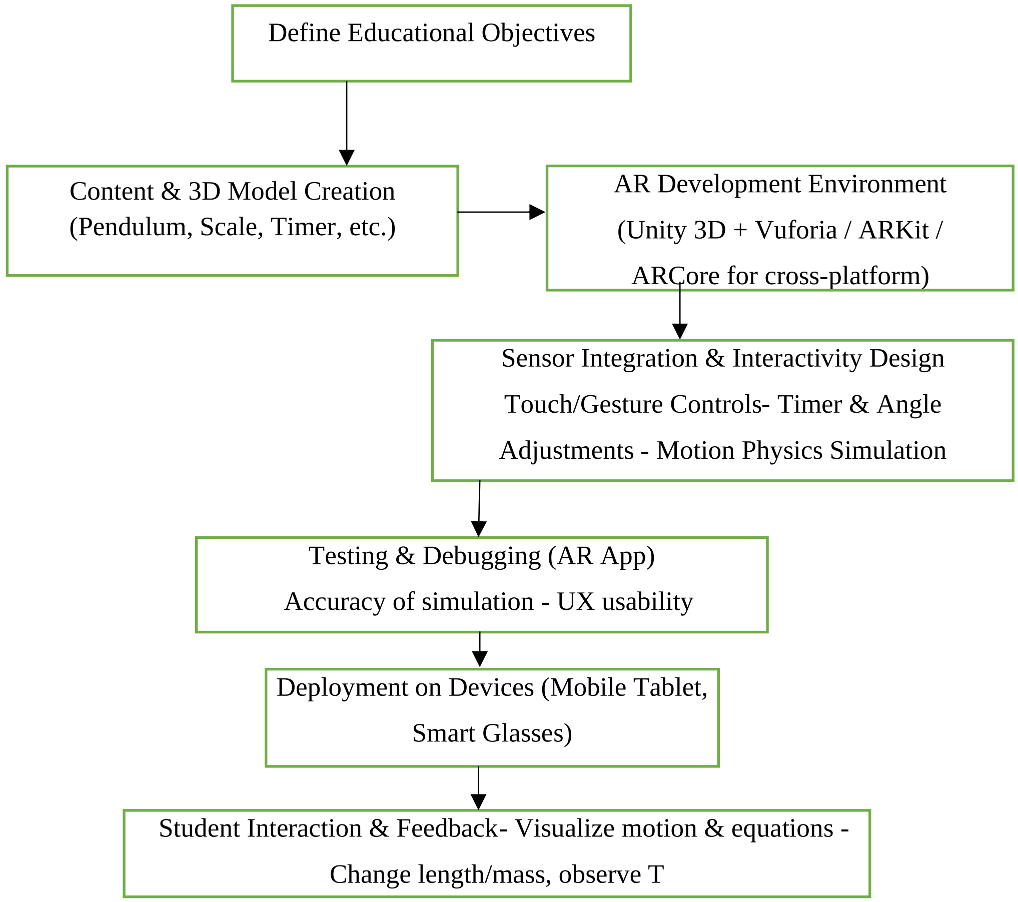

Figure 2: Block Diagram

Understanding time period, amplitude, length, and gravity relation in a pendulum. Designing accurate 3D models of pendulum and visual aids. Unity is commonly used, along with AR SDKs like ARCore (Android) or ARKit (iOS).Physics engine simulates pendulum motion when users adjust parameters. Students use mobile devices to scan markers or environments to view and interact with the AR pendulum. Based on student usage and feedback, educators or developers can iterate and improve.

3.4 Augmented Reality Based E-learning

Augmented Reality technologies are rapidly rising for constructing hybrid systems for a variety of uses, and it is one of the most promising fields of research in recent years. Mobile augmented reality offers a heightened and intricate view of the actual surroundings. AR systems encompass capabilities like instantaneous interaction, 3D alignment, and a fusion of tangible and virtual realms. The way objects appear in the physical world is what distinguishes augmented reality from virtual reality. The predominant form of augmented learning, known as augmented reality, enriches the user's encounter by presenting contextual information.

3.5 Virtual Reality Based E-learning

Though infographics can represent learning information better than text alone, they lack interactivity, which the authors believe is required to build competence and experience via the Internet. Virtual Reality (VR) has been developed with the intention of tackling this challenge and enhancing the interactive nature of online education. Their work underscored enhanced student collaboration and productivity through online tools like. E-learning facilitates learning anytime, anywhere, making knowledge acquisition more accessible. E-learning content encompasses text, graphics, tables, and videos. In order to minimize the need for recurrent parsing, the operators in the library were overloaded to handle arrays of float values. Sigma and Pi notation, like in equation 5, is a prominent exception to this rule:

$$\sum_{k=1}^{20} kx^2 \qquad (5)$$

For them to manage the fluctuation in k, the parser must be called again. Our method involves creating graphical representations in a procedural manner using Unity's Mesh library. This entails generating a sequence of basic quadrilateral "strips" for typical graphs using the user-inputted values. The adoption of e-learning initiatives is on the rise across diverse sectors, including corporate, higher education, government, military, and non-profit organizations. To quantify learning gains from VR/AR environments eqn 6:

$$\text{Normalized Gain }_{(g)} = \frac{\text{Post} - \text{test} - \text{Pre} - \text{test}}{100 - P\text{re} - \text{test}} \qquad (6)$$

Used to compare traditional learning versus VR/AR-enhanced learning.E-learning practices have evolved, resulting in more intricate, sophisticated, and extensive programs due to advancements in design and delivery capabilities.

$$ALE = \beta_1, \left(\frac{\text{Post} - \text{test} - \text{Pre} - \text{test}}{100 - P\text{re} - \text{test}}\right) + \beta_2.IM + \beta_3.ARF \qquad (7)$$

The introduction of Virtual Reality (VR) brings a three-dimensional dimension to education eqn 7. VR technology has become a significant asset to education, transitioning from its traditional application in fields like aviation and medical imaging to classroom settings. Virtual Environments (VE) have been developed for training and education in a number of studies. This chapter explores earlier studies on the incorporation of virtual reality into e-learning platforms.

3.4. Practical Implications

Virtual reality and augmented reality are transforming education by creating immersive, interactive learning environments that captivate students and enhance their understanding and retention of challenging subjects. Here are several potential applications.

- AR and VR technologies can create engaging learning environments with dynamic visuals and auditory cues that capture students' attention and stimulate their curiosity about the material. By offering immersive virtual environments and simulations, AR and VR can increase student interest and involvement in learning, making complex subjects more accessible and engaging.
- The use of AR and VR technology can enhance the relevance of the lessons being delivered. These technologies enable students to explore different environments and interact with the material in a more realistic manner, thereby improving their comprehension of the topics being

studied. Furthermore, these technologies can introduce new ideas and concepts in a more captivating way, which can elevate student interest and participation.

- AR and VR technology has the potential to enhance educational accessibility for students with special needs. These technologies can assist individuals with physical or cognitive challenges by allowing them to experience virtual worlds at their own pace and on their own terms.

WordStat gained acceptance among researchers due to its effective use in content analysis. WordStat aids in understanding the distribution of keywords and word frequency. The study utilized specific phrases to ensure that the texts focused on technology-based applications and refined its search parameters to identify key terms related to AR and VR in education. The top keywords, which include technology, augmented reality, virtual reality, and augmented reality, show that these areas have seen a lot of study attention in the last ten years, underscoring their increasing significance.

Table 2: Word Frequency in Education for AR and VR

Word	**Frequency**
AR	683
Learning	660
Virtual	616
VR	556
Augmented	435
Technology	299
Research	260
Mobile	195
Design	169
Information	145
Construction	137

In order to understand the top 20 words and we also adjust WordStat settings. The information shown in Table 2 explains the most frequently used terms in a sampling of papers. Together with the extension of these abbreviations, AR and VR were among the top five most frequently occurring words.

4 Result and Discussions

The squared period obtained from every angle and length. The link $T^2 \propto L$ for each angle is confirmed by the linear regressions for five angles in Figure 3, which demonstrate strong positive correlations between pendulum lengths and period squared. The pre- and post-test findings for each cluster and overall are displayed in Figure 4. From 31.00 to 66.17, the trend indicates improvement for every sample. More specifically, class A (rural area), which is comparatively distant and has limited access and facilities, surprisingly showed the greatest gain in conceptual understanding. Since this virtual experiment was both the teacher's and the students' first time, the teacher of class A claimed that her students were quite enthusiastic about conducting the research.

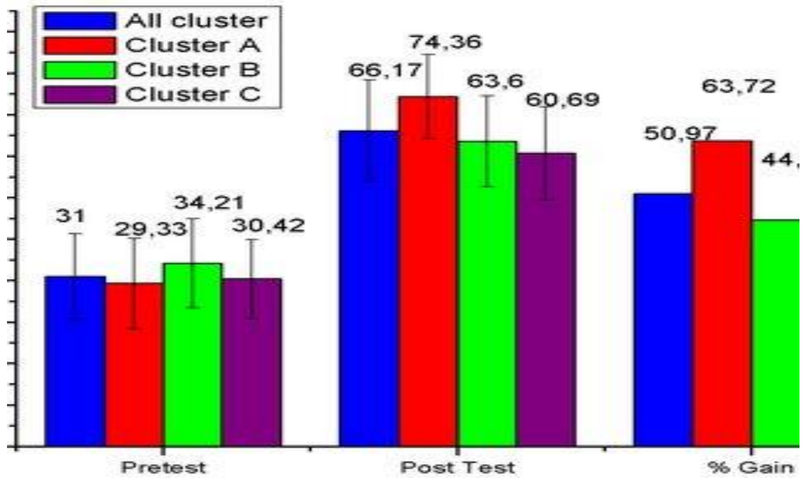

Figure 3: Bar Chart of Pre - Post Test Scores of Students for all Sample

Due to a lack of devices, the majority of students have restricted access to the internet. After that, the school helps them carry out the experiment in the offline simulation mode at the school computer lab.

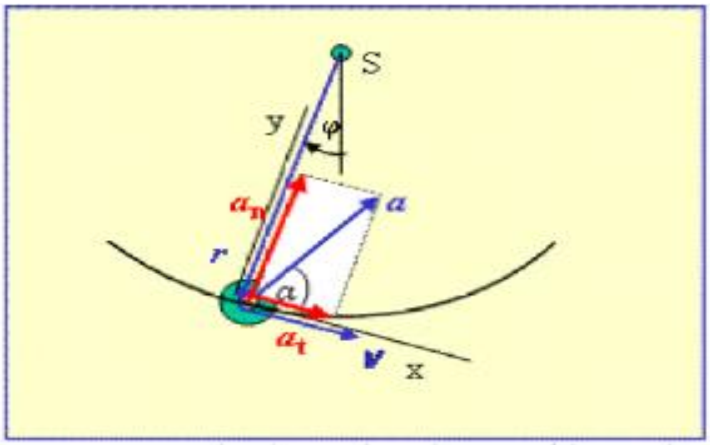

Figure 4: Tangential and Normal Acceleration of the Curvilinear Motion

Additionally, they take turns utilizing their teacher's and friends' devices to complete the test. Despite their limited access and facilities support, this condition shows that they have a strong desire to learn something new. Figure 4. Acceleration of the curvilinear motion, both normal and tangential.

Figure 5: Simple Pendulum for Simple Pendulum

Figure 5 shows an educational video game or simulation, likely used to teach students about simple pendulum experiments. The presence of data tables and signs suggests an interactive learning environment where users can conduct virtual experiments and collect data. The image depicts a 3D rendering of a room with a table and various objects, including a pendulum experiment setup. The scene is set against a gray wall and floor, with a wooden table positioned in the center-right of the image.

Figure 6: Simple Pendulum as 20 cm

Figure 6 shows a black sign on the left side of the table displays white text that reads "Simple Pendulum Experiment". In the middle of the table, a simple pendulum is set up using a black stand and a yellow string attached to a small metal ball. On the right side of the table, another black sign shows the length of the pendulum as 20 cm and a timer displaying 0.00 seconds. Below the timer, there are two buttons labeled "START" and "SUBMIT".

Figure 7: Simple Pendulum Experiment Setup

A table with the following columns is displayed on the sign: "Length of string (cm)", "Time for 10 oscillations (s)", "Period of oscillation T (s)", "T^2 (s^2)", and "1/T^2 (s^-2)." (Fig. 7) The table contains data points for different string lengths, including 20 cm, 30 cm, 40 cm, 50 cm, and 60 cm. All things considered, the picture seems to be a computerized depiction of a physics experiment, most likely for instructional purposes

Figure 8: 3D Rendering of a Simple Pendulum

Figure 8 shows a 3D rendering of a simple pendulum experiment setup, featuring a wooden table with black metal legs. On the table, there is a black stand holding a pendulum consisting of a gray ball attached to an orange string. In the background, a large screen displays a table with columns labeled "(s)" and "(cm/s^2)". The floor is composed of gray tiles, and the walls are painted light gray. In the bottom-right corner, a black box contains the text "Length: 20 cm", "4.59 sec", and two buttons labeled "STOP" and "SUBMIT".This setup appears to be part of an interactive educational tool or simulation, likely used for teaching physics concepts related to pendulums.

Figure 9: Interactive Experiment Related to Simple Pendulums

A table with columns labeled "Length of the Pendulum (cm)," "Time for 20 Oscillations (s)," and "Period of One Oscillation (s)" is projected onto the wall opposite the viewer from a large screen. The columns are labeled "T^2 (s^2)" and "L/T^2 (m/s^2)." Data for pendulums of various lengths, including 20 cm, 30 cm, 40 cm, and 50 cm, are included in the table. Figure 9 show the Overall, the image appears to be a simulation or interactive experiment related to simple pendulums, allowing users to measure and record data for different lengths of pendulums.

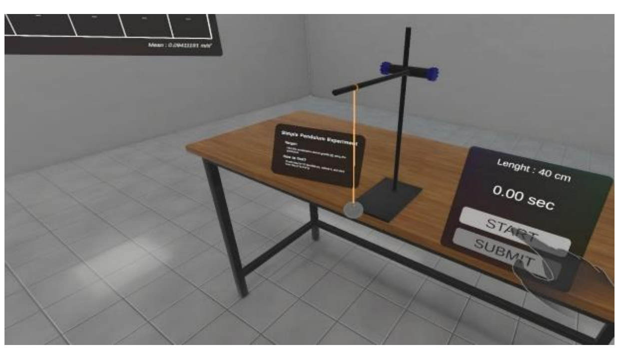

Figure 10: The Image Depicts a Unity Game Development Environment

The scene features a wooden table with black metal legs, accompanied by a black stand holding a blue object resembling a pendulum. A black box on the table displays text, including "Tread Length: 20 cm," "Timer 00 sec," and two buttons labelled "START" and "SUBMIT." The background of the scene is a plain white wall. Figure 10 shows the "Hierarchy" window lists various objects in the scene, while the "Inspector" window displays properties and settings for selected objects. Overall, the image suggests that the developer is working on a physics-based game or simulation, possibly involving pendulums or other oscillating objects. The presence of a timer and submit button implies that the game may involve user input or experimentation.

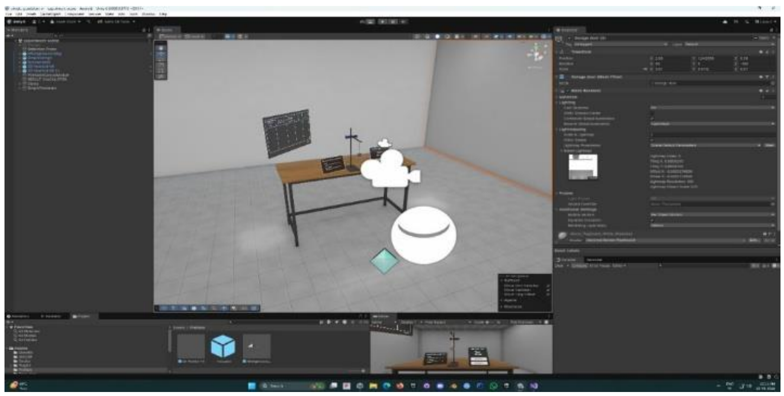

Figure 11: 3D Modeling

Figure 11 suggests that the user is working on a 3D modeling project, possibly creating a scene or environment for a game, animation, or architectural visualization. The presence of a wind vane and a cloud-like object implies that the scene may be outdoors or have some weather elements. The user is likely using the software to manipulate and customize the objects in the scene, adjusting their properties and positions to achieve the desired outcome.

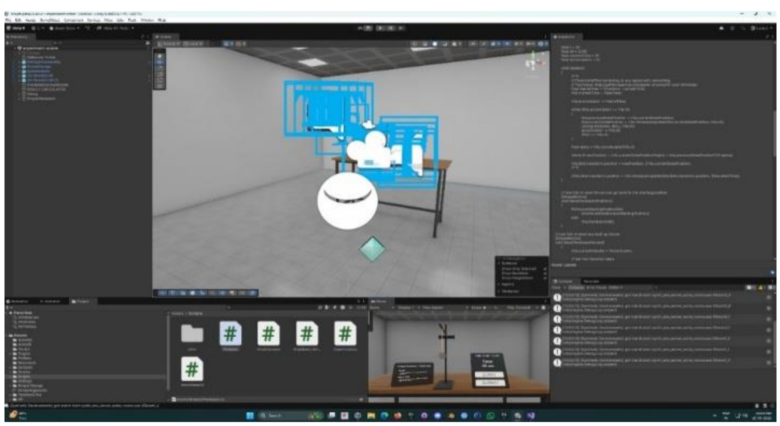

Figure 12: 3D Rendering of a Simple Pendulum Experiment

Figure 12 depict 3D rendering of a simple pendulum experiment setup, featuring a wooden table with black metal legs and a gray tiled floor. The room's walls are painted light gray. On the table, a black stand supports a horizontal bar with blue knobs at each end, from which an orange string hangs down to a small gray ball. To the right of the pendulum, another black sign displays the following information: Length: 40 cm, Time: 0.00 sec and Two buttons labeled "START" and "SUBMIT". In the top-left corner of the image, a partial view of a blackboard or whiteboard is visible, showing a graph with a mean value of 0.0941191 m/s^2. The overall atmosphere suggests a virtual learning environment or simulation for educational purposes.

Figure 13: Window Appears to be a 3D Modelling

Figure 13 illustrates that the user is engaged in a project related to 3D modeling, game development, or the creation of virtual reality. The existence of several windows and software applications suggests a sophisticated workflow, which may involve collaboration or experimentation with various tools and techniques.

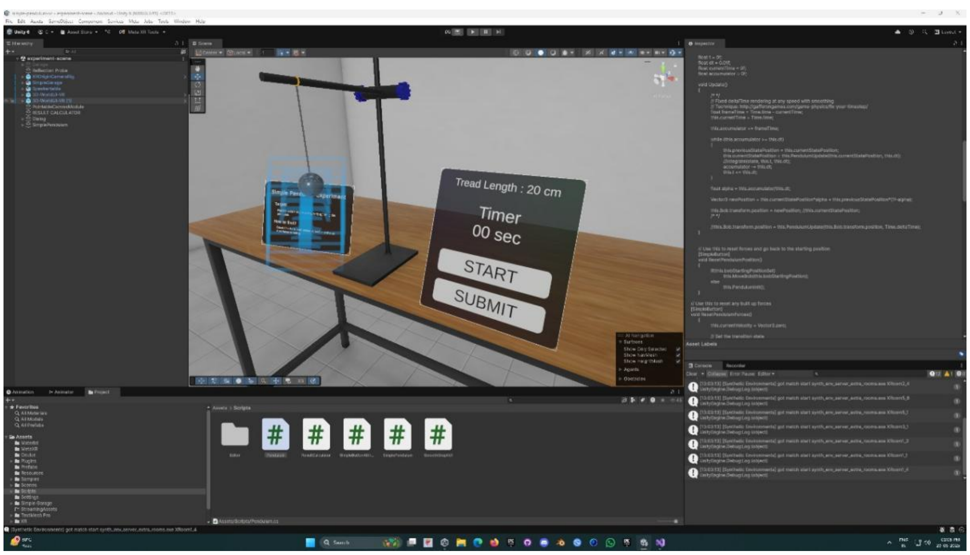

Figure 14: Educational Software

Figure 14 appears to be a component of an educational software or platform aimed at promoting interactive learning experiences. The simulation enables users to perform virtual experiments, gather data, and analyze results within a controlled setting. A timer suggests that the experiment may be measuring time-related phenomena, such as the period of a pendulum or the duration it takes for an object to descend a certain distance. In summary, the image illustrates a contemporary method of science education, utilizing technology to improve student engagement and comprehension.

5 Conclusion

The functionality of the educational environment will ensure the availability of educational content, which includes learning objects in various formats, assessments, and content creation. This involves activities such as developing digital content and metadata descriptions, designing learning objects, creating courses, and managing open-access protocols. Additionally, it includes the creation of tests and assignments, ensuring their alignment with relevant programs, and managing a virtual learning environment along with user administration. Moreover, the learning platform must have the capability to integrate with social media platforms. There is also a need for further exploration into the increasing importance of emerging technologies, their use in new learning environments, and the adoption of innovative platforms. It is expected that the utilization of AR and VR will rise in fields such as healthcare, education, gaming, and retail, offering users immersive, inventive, and creative experiences that enhance engagement and outcomes. Thanks to advancements in software (AI, machine learning) and hardware (wearables, head-mounted displays, haptics), AR and VR are transforming how individuals interact with digital information and altering experiences across various sectors.

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