Learning Outcomes by Integrating Virtual Reality: An Experiment on Secondary School Students

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Abstract

Virtual Reality VR is a modern technological masterpiece; if it is integrated with education, it will make teaching much more accessible, and it can also work as a teacher. Through Virtual Reality, students learn very quickly while being exposed to the original story. The purpose of this research was to conduct a practical experiment on Virtual Reality VR to see the students' learning level and the level of students' excitement and engagement. This educational experiment was conducted on Boys Government High School No. 1 Dera Ghazi Khan Class 10th students. For this purpose, two groups of average intelligent students were formed by taking the pre-test. These groups consisted of 15 to 15 students who were given four months of treatment through Virtual Reality VR. Then, the data were collected and interpreted through statistical tools. From this experiment, it was found that the excitement and engagement of the students taught through Virtual Reality VR were very high, and the scores on the achievement test were also very high. It was recommended that teachers should be aware of this new technology and use it in educational institutions. The government should also allocate a specific budget for new technology.

Keywords: Virtual Reality VR, Integration VR to education; Secondary school students, Learning outcomes; Pedagogy.

Introduction

Virtual reality refers to using specialized electronic gear, such as a helmet with an internal screen or gloves equipped with sensors, to interact with computer-generated images and environments in a way that seems natural or tactile (Makinen et al., 2020).

Really immersive experiences include being inspired by stunning vistas from across the globe, gaining a grasp of physics by flying into space, diving very deep below, exploring the human body's interior, and many more thrilling adventures (Plecher et al., 2022).

Virtual reality creates a one-of-a-kind learning environment that engages and excites several senses. Now, students may immerse themselves in the subject matter by physically experiencing what it's like to be a whale—sight, sound, touch, and smell—or by digitally exploring the ocean alongside whales in 3D visuals. Virtual Reality (VR) has turned students from mere observers of the subject matter into active participants in the learning process. Taking an immersive approach to teaching not only boosts students' interest levels but also provides them with a deeper degree of comprehension, which is essential for concept mastering (Young et al., 2020).

By using computer modelling and simulation, virtual reality (VR) allows users to be fully immersed in an artificial three-dimensional (3D) visual or sensory world (Liu, 2020). Headsets, goggles, gloves, or even full-body suits may be used for data transmission and reception in virtual reality (VR). These devices place the user in a computer-generated setting that seems identical to the real thing. The standard VR setup involves donning a stereoscopic display helmet and seeing animated images of a simulated environment. A user's movements may be detected by motion sensors, which then adjust the screen display accordingly—sometimes even in real-time—to create the impression of "being there" (telepresence). Consequently, the user may confidently move his hands and head to experience various vistas and perspectives as he moves around a virtual suite of rooms. By donning data gloves outfitted with force-feedback devices, the user may experience the feeling of touch and pick up and control virtual things (Ganadas et al., 2021).

Bhatnagar and Boruah (2024), state that Lanier, who introduced the word "virtual reality" for the first time in 1987, was an early pioneer in the VR sector thanks to his engineering and research. U.S. government organizations including the National Science Foundation, the Department of Defense, and the National Aeronautics and Space Administration were essential in the early stages of virtual reality research and development (NASA). In addition to bridging the gap between academia, the military, and industry, the projects funded by these groups and carried out in university research laboratories also generated a large pool of talent in fields like as computer graphics, simulation, and networked environments. This article delves into the social backdrop and development history of this technical accomplishment (Shan, 2023; Amir et al., 2022).

Artists, performers, and entertainers have long made use of techniques that enable the construction of imaginative worlds, the placement of tales in made-up locations, and the manipulation of the senses. Many things came before Virtual Reality in the creative and entertainment media world that allowed people to suspend their disbelief in a made-up

setting. The architecture of dwellings and public places has long relied on creating illusionary settings via paintings or vistas; the vast panoramas of the 18th and 19th centuries were the pinnacle of this practice. Panoramas aimed to make viewers feel as if they were really a part of the action by erasing the lines that generally would have separated the two-dimensional images showing the main scenes from the three-dimensional spaces they were seen from (Hussain et al., 2022; Trumpener & Barringer, 2020). This visual heritage inspired several forms of media development during the twentieth century, such as stereopticons, three-dimensional films, future theatre designs, and IMAX theatres, all with the goal of recreating the same effects as the originals. Cinerama, formerly known as Vitarama, was developed from studies on vision and depth perception by Fred Waller and Ralph Walker. It was initially presented at the 1939 New York World's Fair. Based on his research, Waller concluded that peripheral vision is crucial for total immersion in virtual environments. He set out to create a projection method that could capture the whole range of human eyesight. The Vitarama method relied on an arc-shaped screen, a variety of cameras, and projectors to create the illusion of total immersion for the viewer. Known as the Waller Flexible Gunnery Trainer, the device was effectively used by the Army Air Corps for anti-aircraft training during WWII. A connection like this between the entertainment industry and military simulation helped pave the way for V.R. Vitarama, formerly known as Cinerama, did not achieve commercial success until the mid-1950s (Barron et al., 2022).

Prior to the advent of computers, sensory stimulation seemed like a potential strategy for the creation of virtual worlds. Morton Heilig, a cinematographer, showed a keen interest in Cinerama and three-dimensional films after the premiere of a promotional video titled This Is Cinerama (1952). (Champion, 2021). He followed in Waller's footsteps by studying illusions and human sense drives with the intention of making a "movie of infinite." Heilig built an individual console towards the end of the 1960s that could take in stereoscopic pictures, use a motion chair, play music, modify temperatures, emit odours, and blow air, among other things. He got a patent for this system, which he called the Sensorama Simulator, in 1962. A person's senses might be "stimulated in order to imitate it realistically" using this console. In 1960, while he was working on Sensorama, he also constructed the Telesphere Mask, a head-mounted "stereoscopic 3-D TV display" that he patented. Although Heilig's attempts to sell Sensorama were fruitless, he did add a multiviewer theatre idea to it in the mid-1960s, which he copyrighted as the Experience Theater. At the same time, he created Thrillerama, a comparable system, for the Walt Disney Company (Berkman, 2024).

During the 1950s and 1960s, the foundations for virtual reality were laid in a number of different areas of computing, mainly when it came to three-dimensional interactive computer graphics and the simulation of vehicles and aircraft. Light pens, called initially "light guns," and cathode-ray tube (CRT) displays were first used in Project Whirlwind, a US Navy-funded early-warning radar system, and its successor, the US Air Force-funded SAGE (Semi-Automated Ground Environment) early-warning radar system. Before the SAGE system went live in 1957, these gadgets were already in frequent use by Air Force operators. Aircraft positions might be shown and pertinent data could be altered using these devices (Boslaugh et al., 2022).

Literature Review

A change in nursing education is required to adequately educate nursing students for the ever-changing and more complicated healthcare settings that are occurring as a result of the fast development of information technology and the scarcity of nurses in the profession (Pepin et al., 2017; Juraschek et al., 2019). In 2018, nursing schools in the US rejected 75,029 students who were eligible to enroll in bachelor's degree programs and graduate nursing programs. Faculty shortages, classroom space issues, clinical preceptor shortages, and financial restrictions all played a role in this (Fact sheet, 2019).

Inspiring students to put their academic understanding into practice in real-world clinical situations is the end goal of nursing education (Shin et al., 2015). On the other hand, students' opportunities to get clinical experience with actual patients are hindered by the restricted amount of time they have available for it (Yuan et al., 2012). Nursing process mistakes can occur due to a lack of clinical practice used to educate students in the actual clinical setting. These errors put patients at risk (Uysal, 2016). Nursing educators face several problems, but they must reduce the gap between theory and practice throughout the learning process (Dubovi et al., 2017). Educators have used various instructional methods, including simulation experiences for students, to ensure that nursing education is of a high standard for both quality and safety (Dalton et al., 2015).

Simulation is an effective teaching-learning technique that can accommodate the ever-evolving landscape of nursing education and enhance the quality of the instructional process (Ricketts, 2011; Cant & Cooper, 2017; Umer et al., 2023; Hafeez et al., 2023). Simulation is an essential part of nursing education, as stated by the National Council of State Boards of Nursing (NCSBN) (Alexander et al., 215). In nursing education, simulation as a teaching technique is becoming more widespread. This provides students with chances to put into practice the theoretical knowledge they have acquired (Brewer, 2011). Students are given a wide range of chances to practice their clinical skills via simulation, which allows them to re-create clinical settings, make judgments, and reflect on them in real-time (Flott & Linden, 2016).

Initially used in military and medical research, the virtual world was later adopted for medical education thanks to advancements in simulation technology (Dev et al., 2017; Rosen, 2008). In virtual Reality (VR), users interact with a computer-generated three-dimensional (3D) environment that gives them the impression that they are physically present in space (YEAR, 2016). It provides a first-person active learning experience with different degrees of immersion. To rephrase, it enables users to do a sequence of activities in the virtual environment and interact with physical items (Cao & Cerfolio, 2019; Sherman & Craig, 2018). But, it allows consumers to have a more realistic experience in the digital realm. Virtual reality's ability to simulate makes it an ideal medium for teaching procedures and clinical skills (Kyaw et al., 2021). Simulating real-life scenarios and medical procedures with the use of physical or other interfaces such as a computer keyboard, mouse, speech/voice recognition, motion sensors, or haptic devices is known as virtual reality (VR) simulation (Shin et al., 2019). What we call a "virtual simulation" really involves actual humans interacting with computer-generated models of systems. Because it is not an accurate or real-time event, this simulation is called a "virtual" one. The use of haptic devices to facilitate user interaction with surgical simulators, which provide on-screen procedural instruction, is

another form of virtual simulation (YEAR, 2016). In the field of education, virtual reality has great promise for revolutionizing simulation into a powerful supplemental tool (Shin et al., 2019; Smith & Hamilton, 2015).

As VR technology develops and becomes more widely available, it is causing a revolution in nursing education (Foronda et al., 2017). There has been a surge of interest in the field of nursing education due to the expanding number of subjects taught utilizing virtual Reality (VR), including leadership, communication, decision-making, inclusivity, health assessment, and disaster triage, among many others (Fealy et al., 2019; Wright et al., 2018). Standard definitions of cognitive and skill mastery assessments are as follows: the former measures how well participants grasp abstract ideas. At the same time, the latter assesses how well they can show the application of specific procedures or techniques. Using VR in simulations allows aspiring nurses to gain cognitive and skill mastery via repeated, hands-on practice (Dubovi et al., 2017; Smith et al., 2016). Nursing students may be able to hone their skills in a controlled environment using VR simulations instead of putting actual patients at risk (Weiner et al., 2019). Nearly all students (98%) who took part in a survey on nursing education expressed interest in using virtual simulations in the future (Foronda et al., 2014).

When it comes to specific outcomes, such as knowledge and performance scores, virtual Reality (VR) has not been shown to be more successful than other conventional approaches, according to the findings of specific studies (Farra et al., 2015; Bryant et al., 2015). When it comes to the efficacy of Virtual Reality (VR), there are still certain studies that are inconsistent with one another. Meta-analyses have been made on the usefulness of virtual reality (VR) in some fields of medicine and education (Neguț et al., 2016; Merchant et al., 2014). These studies have been conducted up to this point. To the best of our knowledge, a meta-analysis that evaluates the efficacy of virtual reality (VR) in nursing education does not exist. The efficacy of virtual Reality (VR) simulation on clinical psychomotor skills for pre-registration nursing students was compared to other simulated methodologies. Without doing a meta-analysis, only one journal evaluated and reviewed the VR's value systematically (Rourke, 2020). Research is required to determine the use of Virtual Reality (VR) in nursing education. The goal of this meta-analysis was to find out how well virtual Reality (VR) works for nursing education in terms of participants' performance time, satisfaction with the VR learning intervention, confidence in the content and process, knowledge of the concepts, and skills in demonstrating procedures and techniques (the amount of time spent on the test task).

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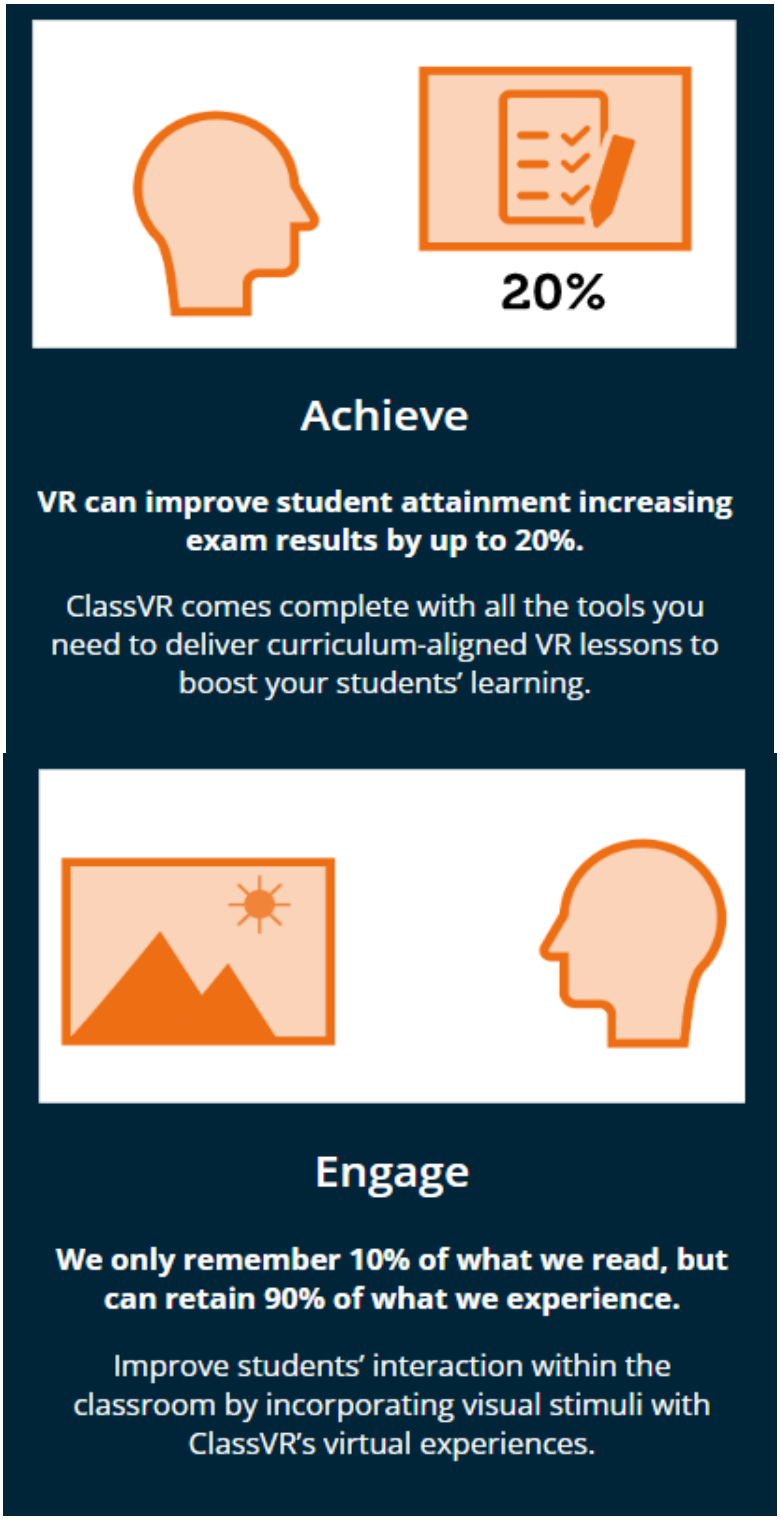

Statement of Problem

With the development of technology, teachers are searching for new teaching methods for effective teaching-learning. By nature, teachers are researchers; teachers teach according to the student's IQ. Some students are fast learners and some are slow learners. Slow learners can be handled by integrating advanced technology. Virtual reality is a trending technology; it can be used in school education, especially in science subjects like physics and biology. It can be used at school levels to teach complex theories and concepts. The present research was a new exploration in the field of education, exploring something new for better teaching, especially science subjects, to secondary-level students. It was an experimental study to teach students through Virtual Reality and research the impacts on students' academic achievement. The study results will be beneficial in the field of education and pedagogy.

Objectives of the Study

The following were the objectives of the study;

1. To see the impact of the Virtual Reality teaching method on students' excitement and engagement.
2. To see the learning outcomes by integrating Virtual Reality in biology subject at the secondary school level.

Hypothesis of the Study

The following were the hypotheses of the study;

Ho.1 The Virtual Reality teaching method does not impact students' excitement and engagement.

Ho.2 There is no impact on learning outcomes by integrating Virtual Reality in biology subject at the secondary school level.

Methods and Procedures

This study was experimental. The study aimed to explore the impact of Virtual Reality on students' excitement, engagement, and academic achievements in biology subject. For this purpose, class 10th students of Government Boys High School No. 1 Dera Ghazi Khan were selected for the experiment. Through cluster sampling class, the 10th Iqbal-Secon class was chosen for the experiment. First of all, students who pre-tested, high achievers and low achievers, were excluded from the study; only average scorer students were selected for this experiment. According to suggestions by Krejcie & Morgan (1970), only 30 intermediate scorer students were chosen out of 73 students for the experiment. Through the fishbowl simple random sampling method, two groups were made. Fifteen students were selected for the control group and fifteen students were chosen for the experimental group.

Experiment Procedure

For the experiment, only one biology subject was chosen; due to a lack of classrooms, the experimental group was treated separately in the computer lab for only one biology period. The control group remained in their class as usual; for the experimental group, Dr Qazi Abdul Ghafor was selected to teach the class integrated through Virtual Reality with the help of an IT teacher. Japan Electronics Franchise D.G. Khan gifted Virtual Reality Gadgets for

experiment. Chapters four to seven of the 10th biology class were already fed in those Gadgets. Franchise experts also helped in this experiment. They aimed to advertise these Gadgets for use in public and private schools.

Treatment

According to the lesson plan, the teacher handed the Virtual Reality Gadgets to students and asked them to visualize them. Prior to this, the teacher taught the required lesson and gave appropriate directions to students. Then, students visualize the required lesion through Virtual Reality and gain knowledge. After visualization, students were asked to discuss their experiences, and the teacher mentored the discussion, corrected misconceptions, and provided further knowledge on the required lesson.

Experiment Duration

The actual duration of the experiment was six months; in the first month, the pre-test was conducted, and groups were made; treatment started in the second month, the total duration of actual treatment was four months, and the last month's data were collected and analyzed, and final results were concluded.

Development of Tools

Two achievement tests were made for data collection; both tests were teacher-made as usual. The first test was used as a pre-test, and the second was from chapters 4 to 7 for post-test; both were traditional achievement tests.

Validity and Reliability of the Tools

Experts validated both tests. Then, reliability was checked through SPSS; the reliability of the first test was .91 and the second test was .89, which was excellent.

Data Analysis Procedure

Two achievement tests were made to assess the student's achievement in biology. The first test was used for the pre-test, and the second for the post-test. Only post-test results were correlated with each other; for this purpose, mean score, standard deviation, and independent sample t-test were applied. Students' excitement and engagement levels were checked through the observation method.

Results of the Study

Ho1. The Virtual Reality teaching method does not impact students' excitement and engagement. All fifteen students in the experimental group were more excited and engaged than the control group students; the null hypothesis was not accepted.

Table No. 1

Ho2. There is no impact on learning outcomes by integrating virtual reality in biology subjects at the secondary school level.

Independent Sample t-test					
Groups	*f*	μ	σ	t	α
Experimental	15	3.8267	.45272	9.313	.000

Controlled	15	2.4533	.34819

Table No. 1 describes the experiment results. It was found that the experimental group's mean was higher than the control group's, and a significant difference between both mean scores was found. The mean value of the experimental group was (3.8267), and the standard deviation was (.45272). The mean value of the controlled group was (2.4533) and the standard deviation was (.34819). The t-test value was (9.313), $p < .05$; the null hypothesis was not accepted.

Research Conclusions

It was concluded that the experimental group's mean score was higher than the control group's. The results of the t-test were found to be significant. There was a significant difference between the achievement scores of the experimental and control groups.

Recommendations

According to the study conclusion, some recommendations were made as follows;

1. It is suggested that teachers learn about new trends in technological pedagogical techniques like Virtual Reality.
2. The public and private sector schools should promote Virtual Reality for better teaching and learning.
3. There is a need to promote virtual reality in education, and all science subjects and literature should be developed in virtual reality.
4. The government should be interested in promoting Virtual Reality in education, especially at the school level, and sufficient funds should be allocated for Virtual Gadgets in the education sector.

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