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Effect of Simulated Learning on Students' Academic Achievement in Science at Elementary Level

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Abstract: *This study was conducted to find out the Effect of Simulated Learning on Students' Academic Achievement in Science at the Elementary Level. Simulated learning as an innovative method has gained considerable attention nowadays. It involves using technology and virtual environments to replicate real-life scenarios or experiences for educational purposes. The major objectives of the study were to analyze teachers' perceptions of simulated learning and to study the challenges teachers face when using simulated learning in their instruction. The researcher used a descriptive survey design. All the male and female elementary science teachers from the Muzaffargrh and Layyah districts were considered part of the study population. The study sample was comprised of 303 elementary school science teachers who were selected randomly. A 45-item questionnaire was used. The researcher used descriptive and inferential statistical techniques to analyze the collected data using SPSS. The results revealed that teachers generally expressed positive views on the use of simulated learning for the teaching of science. It was recommended that simulated learning activities be aligned with the science curriculum. Guidelines and frameworks should be formulated to facilitate the seamless integration of simulated learning into existing educational frameworks. Teachers should be supported in adapting their teaching methods to fit simulated learning environments.*

Key Words: Simulation, Technology, Academic Achievement, Science, Elementary Level

Introduction

Simulated learning has the potential to revolutionize science education at the elementary level by providing students with hands-on, experiential learning opportunities that foster deeper understanding, critical thinking, and problem-solving skills. Simulated learning has emerged as a valuable tool in education, offering students the opportunity to engage in realistic and interactive learning experiences. Simulated learning can provide a platform for inquiry-based learning, collaboration, and exploration of scientific concepts (Yuan et al., 2020). Simulations can be tailored to specific scenarios, allowing users to adjust parameters, inputs, and conditions to explore various outcomes and scenarios (Banks, 2001).

Furthermore, simulated learning has particular relevance in the domain of science education. It offers opportunities for elementary students to explore scientific concepts through interactive simulations, virtual experiments, and immersive experiences. Simulations can bridge the gap between theoretical knowledge and practical application, promoting a deeper understanding of scientific principles. Simulated learning can facilitate the development of critical thinking and problem-solving skills among elementary students. By engaging in simulations that require decision-making, analysis, and reflection, students can enhance their cognitive abilities, analytical thinking, and reasoning skills. (Akçayır & Akçayır, 2017)

Different types of simulations used in the teaching of general science at the elementary level encompass various interactive and immersive experiences that allow students to explore scientific concepts and phenomena. These simulations can be categorized into virtual simulations, physical

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simulations, and augmented reality simulations. Virtual simulations utilize computer software or online platforms to create realistic and interactive virtual environments where students can engage with scientific phenomena. These simulations often involve interactive models, simulations of laboratory experiments, or virtual field trips. For example, students can use virtual simulations to explore the water cycle, observe chemical reactions, or investigate ecosystems in a controlled and safe environment. Virtual simulations offer opportunities for active learning, experimentation, and exploration of scientific concepts (Smith & Johnson, 2020).

Physical simulations involve hands-on manipulations of physical materials or objects to simulate scientific phenomena. These simulations often include science kits, models, or manipulatives that allow students to observe and interact with real-world phenomena. Augmented reality (AR) simulations overlay digital content onto the real-world environment, enhancing students' perception and understanding of scientific phenomena. AR simulations can be accessed through mobile devices or wearable technology, providing students with a blended experience of the physical and virtual worlds. For example, students can use AR applications to explore anatomy by overlaying virtual organs onto a physical human body or to interact with virtual animals in their natural habitats. By utilizing virtual, physical, and augmented reality simulations, educators can enhance students' scientific exploration, critical thinking, and application of knowledge (Wang & Sun, 2021).

Science education at the elementary level plays a crucial role in laying the foundation for students' understanding of the natural world, fostering curiosity, critical thinking, and problem-solving skills. Science education explodes students' curiosity about the world around them and encourages them to ask questions, make observations, and seek explanations. By engaging in hands-on activities and investigations, students develop inquiry skills and a sense of wonder about scientific phenomena. Elementary science education provides students with a solid foundation in scientific concepts, principles, and processes. By leveraging the advantages of simulated learning, it is possible to enhance student engagement, promote active learning, and foster conceptual understanding in the teaching and learning of science. Simulated learning can help address the challenges in the provision of quality education, specifically in the subject of science. This research aimed to highlight the prospects of simulated learning at the elementary level in Pakistan.

Statement of the Problem

Science education at the elementary level faces various challenges that can impact students' learning experiences and hinder their development of scientific literacy. One of the primary challenges in elementary science education is the presence of curriculum constraints, including time limitations and overcrowded classrooms. It has resulted in a narrow focus on basic concepts and a lack of depth in understanding scientific principles. Simulated learning can be adjusted to individual students' needs and learning styles. This personalization can help students who may struggle with traditional teaching methods. The researcher proposed to study the effect of simulated learning in resolving the abovementioned issues and enhancing students' achievement in the subject of science. Another problem is that not all schools have the right technology or training to use simulated learning properly. The researcher also addressed this issue.

Objectives of the Study

The objectives of this study were:

1. To study teachers' perceptions about the effect of simulated learning on students' academic achievement.
2. To identify challenges faced by teachers in using simulated learning.

Literature Review

Simulations are valuable educational tools, allowing students to explore concepts and principles in a dynamic, interactive environment. They are used in various fields, including STEM education, healthcare training, and military simulations. Simulations are essential for studying climate patterns, environmental changes, and their impacts. They help researchers understand complex interactions between the atmosphere, oceans, land, and biosphere (Jones et al., 2019). Simulated learning allows instructors to create standardized scenarios that can be consistently replicated for all learners. This ensures that all learners are exposed to the same learning opportunities and challenges, promoting fairness and equity (Dieckmann et al., 2007). Simulated learning provides immediate feedback to learners, allowing them to assess their performance and identify areas for improvement in real time. Feedback mechanisms may include debriefing sessions, performance metrics, and self-assessment tools (Issenberg et al., 2015).

In today's classrooms, simulations techniques such as augmented reality as well as virtual reality has made the learning process very effective and motivating. AR techniques has made learning process quite easy, and a fun if compared with traditional methods. AR has introduced focused learning along with interactivity in educational content (Afnan et al., 2021).

Many simulations offer visual representations of data and processes, enhancing understanding and engagement. Interactive features allow users to manipulate variables and observe real-time changes, fostering exploration and learning. Simulations can model systems of varying scales, from microscopic interactions to global phenomena. This scalability enables analysis at different levels of detail and abstraction. Simulations are widely used in physics and engineering to model complex systems such as fluid dynamics, structural mechanics, and electromagnetism. They help optimize designs, predict performance, and identify potential issues before physical implementation. In medicine; simulations are used for patient-specific modelling, drug development, and surgical training. In biology, they aid in understanding biological processes, population dynamics, and ecosystems. Simulations play a crucial role in studying celestial phenomena, from the formation of galaxies to the dynamics of planetary systems. They help astronomers interpret observations and test theoretical models. Economic simulations model market behaviour, policy impacts, and financial instruments. They assist policymakers, analysts, and investors in making informed decisions and understanding complex economic dynamics (Law et al., 2007).

Types of Simulated Learning

Virtual Reality (VR) Simulations: In science, technology, engineering, and mathematics (STEM) education, VR simulations offer interactive ways to explore complex phenomena such as molecular structures, physics experiments, and geological formations. Medical professionals can practice surgical procedures, patient interactions, and diagnostic skills in risk-free virtual environments, enhancing their clinical competence. VR simulations enable learners to experience historical events, explore cultural landmarks, and immerse themselves in different time periods and places. Learners can engage in realistic conversations with virtual native speakers, facilitating language acquisition and cultural understanding. Students can virtually visit museums, historical sites, and natural wonders, expanding their horizons beyond the confines of the classroom (Sawyer & Chamilothori, 2019).

Augmented Reality (AR) Simulations: Sahin and Yilmaz (2020) are of the view that students' high attainments and a definite positive attitude are observed due to AR learning material. AR is a source of entertainment for children as they learn using its capacity for the user interaction (De Lisi & Wolford, 2002). Furthermore, Hsiao et al. (2016) exposed that AR techniques catch students' attention and interest during learning process.

Simulation Games: Simulation games are interactive digital experiences that enable players to engage with complex scenarios, make decisions, and witness the consequences of their choices. Simulation games in environmental science allow players to manage ecosystems, address pollution, and make sustainability decisions. These games promote ecological awareness and understanding (Green et al., 2021). Engineering simulation games facilitate the design and testing of engineering projects, encouraging students to optimize designs and solve engineering challenges (Lee et al., 2021).

Computer-Based Simulations: Computer-based simulations are educational tools that use software applications and digital models to replicate real-world processes, phenomena, or scenarios. They have become increasingly prevalent in education due to their ability to engage students in hands-on learning experiences. Computer-based simulations are powerful tools used across various fields to model real-world phenomena, systems, or processes in a virtual environment. These simulations rely on mathematical algorithms and computational power to mimic the behavior of complex systems, providing insights, predictions, and opportunities for experimentation without the need for real-world implementation. They have wide-ranging applications in fields such as science, engineering, medicine, economics, and education. Computer-based simulations strive to accurately represent the behavior of real-world systems (Smith & Johnson, 2020).

Role-Playing Simulations: Role-playing simulations often incorporate feedback mechanisms to provide participants with insights into their performance and decision-making processes. Reflection sessions allow participants to analyze their actions, outcomes, and the implications of their choices. Role-playing simulations are widely used in educational settings to enhance learning outcomes. In disciplines such as history, literature, or social studies, simulations can bring historical events or literary works to life, allowing students to immerse themselves in the context and gain a deeper understanding of the subject matter (Ramage et al., 2012). Organizations use role-playing simulations to prepare for crisis situations such as natural disasters, cyber security breaches, or public relations crises. By simulating realistic scenarios, teams can test their response strategies, identify gaps in preparedness, and refine their crisis management plans (Farazmand, 2017). Role-playing simulations have therapeutic applications in fields such as counselling and psychotherapy. Therapists may use simulations to help clients explore interpersonal dynamics, practice coping strategies, or rehearse challenging conversations (Gladding & Newsome, 2010).

Flight and Driving Simulators: Flight and driving simulators are sophisticated training tools that replicate the experiences of piloting aircraft or operating vehicles. These simulators provide realistic environments where learners can practice manoeuvres, procedures, and decision-making in safe and controlled settings (Smith & Johnson, 2020).

Laboratory Simulations: Laboratory simulations can accommodate a wide range of experiments and scientific concepts, from basic principles to advanced techniques. They can be scaled to meet the needs of different educational levels, courses, and learning objectives. Laboratory simulations are widely used in science education at both the K-12 and higher education levels. They supplement traditional laboratory instruction, allowing students to practice experimental techniques, reinforce concepts, and develop critical thinking skills (Ketelhut et al., 2010).

Language Learning Simulations: Language learning simulations are used for proficiency assessment and certification purposes. They assess learners' language skills across various domains, such as speaking, listening, reading, and writing, providing objective measures of proficiency (Brown & Hudson, 2002). Simulations are utilized in distance learning programs and online language courses to create interactive and engaging learning experiences. Learners can access simulations remotely, allowing for flexible scheduling and individualized study (Shannon & Chapelle, 2017). Simulations are valuable tools for language maintenance and self-study purposes. Learners can use simulations to practice language skills independently, reinforce previous learning, and stay engaged with the language outside of formal instruction (McCarthy, 2016).

Advantages of Simulated Learning

Research by Clark et al. (2018) shows that students are more motivated and excited when they do simulated learning compared to traditional methods. Secondly, simulated learning gets students active and focused. Through simulations, students can apply what they learn to real situations, helping them understand difficult ideas better. This hands-on approach makes students think deeper and remember more. Simulated learning helps students become better at thinking critically and making decisions. By facing challenges in simulated scenarios, students learn to analyze problems, weigh options, and make smart choices.

Simulated learning can be customized to meet individual learner needs. Learners can engage in simulations at their own pace, receive personalized feedback, and access resources tailored to their specific learning requirements. This customization helps address learners' diverse needs, learning styles, and proficiency levels, promoting individualized and self-paced learning experiences. Simulated learning allows learners to practice skills repeatedly, promoting mastery and skill development. Learners can engage in simulations multiple times to reinforce their understanding, practice complex tasks, and gain confidence in their abilities. This repetitive practice fosters skill transfers and long-term retention of knowledge (Alfieri et al., 2011). Simulated learning provides a safe environment for learners to practice skills and make mistakes without consequences. In fields such as healthcare, where errors can have serious implications, simulation allows learners to gain hands-on experience in a risk-free setting (Okuda et al., 2009). Simulated learning enables learners to engage in repetitive practice, allowing them to reinforce skills, procedures, and decision-making processes. Learners can repeat simulations multiple times until they feel confident and proficient in their abilities (McGaghie et al., 2010).

Simulated learning can be tailored to the specific needs, learning objectives, and skill levels of learners. Instructors can modify scenarios, adjust difficulty levels, and provide individualized feedback to meet the unique learning needs of each learner (Lateef, 2010). Simulated learning encourages interdisciplinary collaboration by bringing together learners from different backgrounds, professions, and expertise areas. Collaborative simulations promote teamwork, communication, and mutual understanding, reflecting real-world practice (Campbell & Daley, 2017).

Simulated learning allows instructors to create standardized scenarios that can be consistently replicated for all learners. This ensures that all learners are exposed to the same learning opportunities and challenges, promoting fairness and equity (Dieckmann et al., 2007). Simulated learning provides immediate feedback to learners, allowing them to assess their performance and identify areas for improvement in real-time. Feedback mechanisms may include debriefing sessions, performance metrics, and self-assessment tools (Issenberg et al., 2015). Research by Cant and Cooper (2017) shows how simulated learning helps healthcare workers improve their thinking skills. Additionally, simulated learning gets students ready for the real world. By simulating actual workplaces, students gain practical experience and learn important skills for their future jobs.

Problems and Issues of Simulated Learning

Simulated learning experiences may vary in the degree of interactivity and feedback provided to learners. Some simulations may lack opportunities for learners to actively engage and manipulate variables, limiting the scope of experiential learning. Similarly, inadequate or delayed feedback may hinder learners' ability to understand the consequences of their actions and make adjustments. While simulated learning can enhance learner engagement, it may not be equally effective for all students. Learners with low motivation or limited interest in the subject matter may struggle to stay engaged and motivated in simulated learning environments. Intrinsic motivation factors, such as curiosity and interest, need to be supported and nurtured to ensure sustained engagement (Sitzmann, 2011). Assessing and evaluating learning outcomes in simulated learning environments can present challenges. Traditional assessment methods, such as multiple-choice tests, may not capture the full range of skills and competencies developed through simulated learning. Developing appropriate and valid assessment measures that align with the unique characteristics of simulated learning is crucial (Sitzmann, 2011). Simulated learning creates artificial environments that might not feel like real life. This can make it hard for students to use what they learn in actual situations.

Research by Schmidt et al. (2018) suggested that students who mostly learn through simulations might find it tough to apply their knowledge in real life. Simulated learning might not offer enough interaction and feedback. While it tries to be interactive, it can't match the spontaneity of real-life interactions. This lack of interaction could make it harder for students to develop problem-solving skills. Also, students might not always get feedback when they need it, which can limit their chances to improve. Simulated learning relies heavily on technology. Simulations might not feel real enough. To be effective, simulations need to be very realistic, but this can be hard to achieve and expensive (Dieckmann et al., 2007). If the simulations aren't realistic enough, they might not engage students fully or accurately represent real-life situations (Gordon et al., 2001).

In some fields like healthcare education, simulated learning might focus too much on technical skills and not enough on other important skills like communication and empathy (Bearman et al., 2015). This imbalance could mean that students miss out on important aspects of their education (Kneebone et al., 2010). While simulated learning has its benefits, it also has its drawbacks. Teachers and designers need to think carefully about these issues and find ways to address them in their teaching.

Dealing with the challenges and issues of simulated learning requires careful planning and implementation of various strategies. To enhance the realism and authenticity of simulated experiences, educators can create scenarios that closely resemble real-world situations and incorporate realistic elements such as props and lifelike simulators. By integrating real-world challenges into simulations, students can better bridge the gap between simulated and actual performance (Schmidt et al., 2018).

Prospects of Simulated Learning in Pakistan

Simulated learning holds significant prospects for elementary-level education in Pakistan. By leveraging the advantages of simulated learning, it is possible to enhance student engagement, promote active learning, and foster conceptual understanding in various subject areas. Simulated learning can help address the challenges of limited access to quality education in Pakistan, especially in remote or underserved areas. By utilizing technology and online platforms, simulated learning can provide equitable access to interactive and engaging learning experiences, regardless of geographical location (Khan et al., 2019).

Effect of Simulated Learning on Teaching of Science at the Elementary Level

Simulated learning, a pedagogical approach that replicates real-world scenarios in a controlled environment, has gained recognition for its potential to transform science education at the elementary level in Pakistan. This educational innovation involves creating dynamic and interactive simulations that enable students to engage with scientific concepts in a hands-on manner. Research on the effect of using simulated learning in the context of elementary science education in Pakistan has shown promising outcomes. Ali & Khan (2019) conducted a study titled "The Impact of Simulated Learning on Elementary Students' Academic Achievement", where they investigated the effects of simulated learning on academic achievement among elementary students in Pakistan. The study found that simulated learning positively influenced students' academic performance by providing them with an interactive and engaging learning experience.

Effects of Simulated Learning on Academic Achievement

Increased engagement and motivation contribute to improved academic achievement. Simulated learning is becoming more popular in schools because it helps students learn better. It makes learning fun and interesting. When students use simulated learning, they get to do things like experiments and activities that make them curious and engaged. This makes learning more exciting and helps students remember what they have learned for a long time (Clark et al., 2018). Simulated learning also makes students more active in their learning. They get to try things out and see how they work. This helps them understand things better and remember them. When students actively take part in learning, they can understand even complicated things and use them in different situations. Simulations often provide instant feedback to students, allowing them to learn from their mistakes and adjust their understanding in real time. This can accelerate the learning process (Paige, 2015).

In a country like Pakistan, where access to quality education can be challenging, simulated learning can level the playing field. It can be accessed online, allowing students from various locations to access the same educational resources (Ally, 2019). Simulated learning can facilitate the integration of various subjects within the context of General Science. For example, simulations can explore the connections between science and mathematics or science and technology, promoting a holistic understanding of the subject. Simulated learning can help elementary students develop skills and familiarity with technology that will be increasingly important in their future education and careers (Papastergiou & Mastrogiannis, 2021). Simulated learning can be cost-effective in the long run as it reduces the need for physical materials and laboratory resources. This can be particularly beneficial in resource-constrained educational environments.

Another good thing about simulated learning is that it helps students think critically. They get to solve problems and make decisions in situations that feel real. This helps them learn how to think carefully and make good choices, which are important skills for doing well in school. Simulated learning also gets students ready for the real world. Simulated learning helps students work together and learn from each other. They get to work on projects that need different skills, so they learn how to work in teams. This helps them see how different subjects are connected and how they can use what they learn in one subject in other areas, too (Cant & Cooper, 2017).

Problems of Simulated Learning in Pakistan

While simulated learning holds promise for elementary-level instruction in Pakistan, there are certain challenges and problems that need to be addressed. Many schools, especially those in rural and underserved areas, lack the necessary infrastructure, computers, and internet connectivity to support simulated learning initiatives. Language barriers can pose a significant challenge in the implementation of simulated learning in Pakistan. While there is a diverse linguistic landscape in the country, the availability of quality educational resources and simulations in local languages may be limited. This can create difficulties for students who are more comfortable learning in their native language.

It is crucial to prevent further marginalization of disadvantaged groups. Efforts must be made to bridge the digital divide and provide access to technology and simulated learning opportunities for all students, regardless of their socioeconomic status or geographic location (UNESCO, 2020). However, it is important to note that while the effects of using simulated learning for teaching science at the elementary level in Pakistan are generally positive, challenges remain. Infrastructure limitations, such as access to technology and reliable internet connectivity, can hinder the widespread implementation of simulated learning. Furthermore, teacher training is essential to effectively integrate this innovative approach into the curriculum and ensure that it aligns with the learning objectives set by Pakistan's educational authorities (Zia et al., 2006). Addressing these problems requires a comprehensive approach that involves investment in technology infrastructure, professional development for teachers, localization of content, and ensuring equitable access to resources.

Research Methodology

In this study, descriptive quantitative research design was employed. The population of this study comprises science teachers actively serving in public schools within the districts of Layyah and Muzaffargrh. The present study's sample size is comprised of 303 elementary school teachers, which is in accordance with Krejcie and Morgan's table (Krejcie & Morgan, 1970). A survey questionnaire was developed to explore the perceptions of science teachers.

Analyses

The researcher performed descriptive and inferential analyses in relation to the objectives of the study. Table 1 (a) and Table 1(b) offer the descriptive analysis of the first objective, while Table 4.2 provides the descriptive analysis of the second objective.

Teachers' Perception of Effect of Simulated Learning on Students' Performance

Table 1 (a)

Teachers' Perception of Effect of Simulated Learning on Students' Performance

S#	Statement	SA %	A %	N %	DA %	SDA %	Mean	S.D
1	Simulated learning helps students understand complex concepts more effectively.	39.6	36.3	5.9	13.6	4.8	3.92	1.19
2	Simulated learning activities are engaging and motivate for students to participate actively.	22.3	42.5	11.4	17.6	6.2	3.57	1.19

3	Simulated learning has positively impacted students' problem-solving skills.	17.6	39.6	13.2	18.7	11.0	3.34	1.27
4	Simulated learning allows students apply theoretical knowledge in practical scenarios.	23.4	40.3	7.3	20.5	8.4	3.49	1.28
5	Compared to traditional learning methods, simulated learning improves students' learning experience.	25.3	33.0	11.0	22.0	8.8	3.43	1.31
6	Simulated learning positively influences students' retention of course material.	23.1	31.9	13.9	20.9	10.3	3.36	1.31
7	The use of simulated learning increases students' interest in the subject matter.	24.5	33.3	10.3	22.0	9.9	3.40	1.33
8	Simulated learning makes learning process enjoyable for students.	24.9	37.4	12.5	16.8	8.4	3.53	1.26
9	simulated learning positively impacts students' overall academic performance.	27.1	35.5	8.8	22.0	6.6	3.54	1.27
10	Simulated learning provides a practical and realistic learning experience.	27.1	39.9	11.4	12.5	9.2	3.63	1.25

Table 4.1 (a), presents results of perception of teachers regarding effects of simulated learning on students' performance. The mean scores, ranging from 3.34 to 3.93, support these positive perceptions, with higher scores indicating stronger agreement. These findings collectively underscore the perceived effectiveness and positive influence of simulated learning on various aspects of the educational experience, reflecting a favorable attitude among the surveyed participants.

Figure 1

Teachers' Perception of Effect of Simulated Learning on Students' Performance

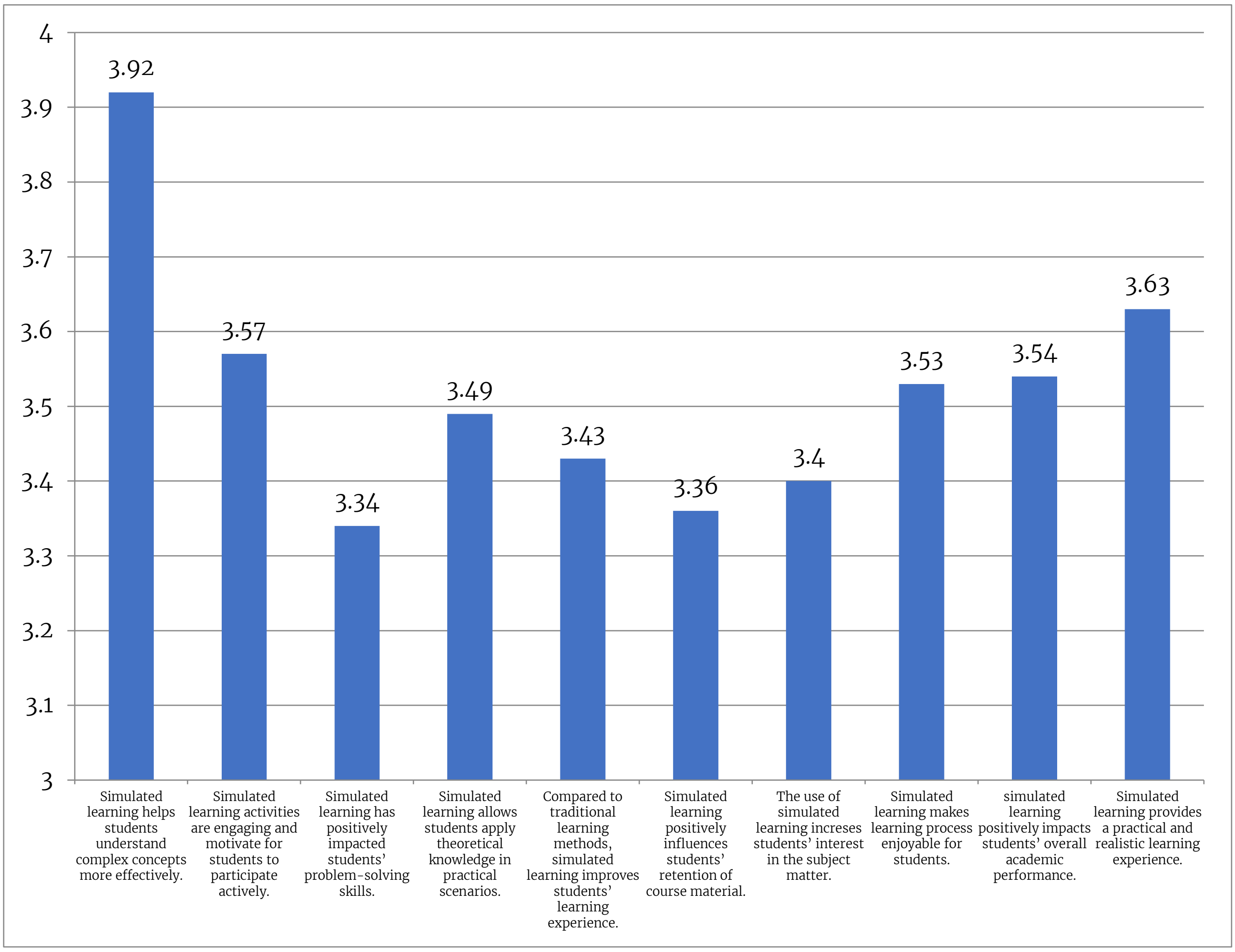


Table 1 (b)

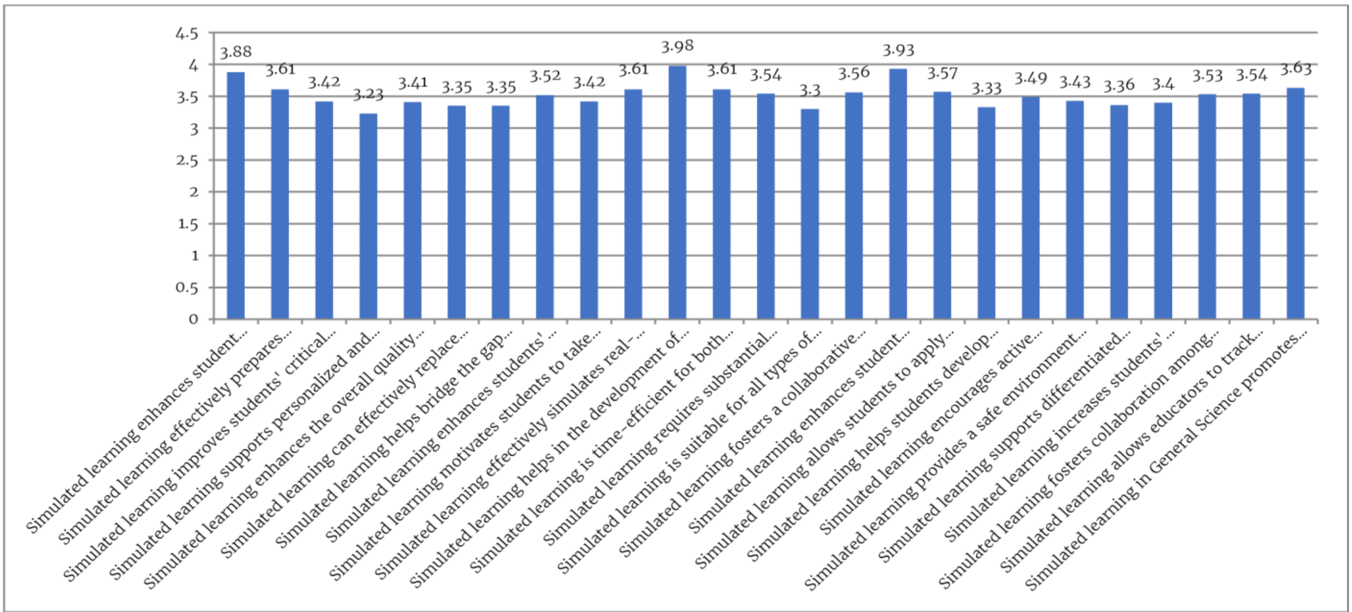
Teachers Perception of Advantages of Simulated Learning

S.#	Statement	SA %	A %	N %	DA %	SDA %	Mean	S.D
1	Simulated learning enhances student engagement and participation.	45.80	27.80	3.70	14.30	8.40	3.88	1.34
2	It effectively prepares students for real-world scenarios.	17.90	52.00	8.10	17.20	4.80	3.61	1.10
3	It improves students' critical thinking skills.	19.40	35.20	18.30	23.10	4.00	3.42	1.15
4	It supports personalized and adaptive learning experiences.	19.41	34.07	10.26	22.71	13.55	3.23	1.35
5	It enhances the overall quality of education.	24.18	37.00	6.59	20.51	11.72	3.41	1.35
6	It effectively replaces traditional teaching methods.	18.68	38.46	9.16	26.74	6.96	3.35	1.24
7	It helps bridge the gap between theory and practice.	20.50	34.10	13.60	24.20	7.70	3.35	1.26
8	It enhances students' problem-solving abilities.	24.18	37.73	10.26	21.98	5.86	3.52	1.23
9	It motivates students to take ownership of their learning.	22.71	37.00	10.26	20.51	9.52	3.42	1.29
10	It effectively simulates real-world challenges and scenarios.	31.14	35.90	6.96	15.38	10.62	3.61	1.34
11	Simulated learning helps in the development of practical skills.	38.8	41.0	4.4	11.7	4.0	3.98	1.12
12	It is time-efficient for both students and teachers.	23.4	45.4	7.3	16.8	7.0	3.61	1.21
13	It requires substantial technological resources.	19.0	43.6	17.2	12.8	7.3	3.54	1.15
14	It is suitable for all types of learners.	19.4	37.4	8.4	24.2	10.6	3.30	1.31
15	It fosters a collaborative learning environment.	26.0	41.0	7.3	15.0	10.6	3.56	1.30
16	It enhances student engagement in General Science lessons.	39.9	36.3	5.5	13.6	4.8	3.93	1.19
17	It allows students to apply theoretical concepts to real-world scenarios effectively.	22.3	42.9	11.0	17.6	6.2	3.57	1.19
18	It helps students develop problem-solving skills in Science.	17.6	39.6	12.8	19.0	11.0	3.33	1.27
19	It encourages active participation and interaction among students.	23.4	40.3	7.0	20.9	8.4	3.49	1.28
20	It provides a safe environment for students to make mistakes and learn from them.	24.9	33.3	10.6	22.3	8.8	3.43	1.31
21	It supports differentiated instruction to meet the diverse needs of students.	23.1	31.9	13.6	21.2	10.3	3.36	1.31
22	It increases students' retention of Science concepts.	24.5	33.3	9.9	22.3	9.9	3.40	1.33
23	It fosters collaboration among students.	24.9	37.4	12.1	17.2	8.4	3.53	1.26
24	It allows educators to track and assess student progress more effectively.	27.1	35.5	8.8	22.0	6.6	3.54	1.27
25	Simulated learning in Science promotes critical thinking skills development.	27.1	40.3	11.0	12.5	9.2	3.63	1.25

Table 1(b) provides insights into teachers' perceptions of simulated learning, with Mean scores and SD offering additional context regarding the consensus and variability of opinions. Overall, simulated learning appears to be positively perceived by teachers across various dimensions. Statements with higher Mean scores generally indicate stronger agreement among teachers. For instance, simulated learning is believed to significantly enhance student engagement and participation (Mean: 3.88, SD: 1.34). However, there are statements where Mean scores are relatively lower, indicating less unanimous agreement among teachers. For instance, there is still agreement that simulated learning supports personalized and adaptive learning experiences (Mean: 3.23, SD: 1.35). Similarly, statements such as the effectiveness of simulated learning in replacing traditional teaching methods (Mean: 3.35, SD: 1.24) and its suitability for all types of learners (Mean: 3.30, SD: 1.31) also show a less cohesive agreement among teachers.

Figure 2

Teachers Perception of Advantages of Simulated Learning



The Challenges Faced by the Teachers in Using Simulated Learning in their Instruction

Table 2

The challenges faced by the teachers in using simulated learning in their instruction

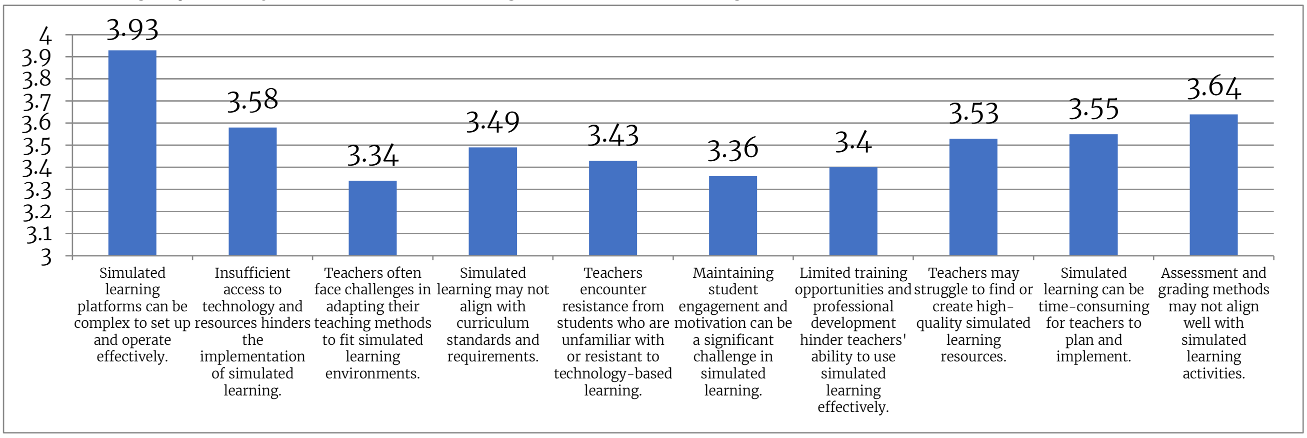
S.#	Statement	SA %	A %	N %	DA %	SDA %	Mean	S.D
1	Simulated learning platforms are complex to set up and operate effectively.	39.9	36.3	5.5	13.6	4.8	3.93	1.19
2	Insufficient access to technology and resources hinders the implementation of simulated learning.	22.3	42.9	11.0	17.6	6.2	3.58	1.19
3	Teachers often face challenges in adapting their teaching methods to fit simulated learning environments.	17.6	39.6	12.8	19.0	11.0	3.34	1.27
4	Simulated learning is aligned with curriculum standards and requirements.	23.4	40.3	7.0	20.9	8.4	3.49	1.28
5	Teachers encounter resistance from students who are unfamiliar with or resistant to technology-based learning.	24.9	33.3	10.6	22.3	8.8	3.43	1.31
6	Maintaining student engagement and motivation is a significant challenge in simulated learning.	23.1	31.9	13.6	21.2	10.3	3.36	1.31
7	Limited training opportunities and professional development hinder teachers' ability to use simulated learning effectively.	24.5	33.3	9.9	22.3	9.9	3.40	1.33

8	Teachers struggle to find or create high-quality simulated learning resources.	24.9	37.4	12.1	17.2	8.4	3.53	1.26
9	Simulated learning is time-consuming for teachers to plan and implement.	27.1	35.5	8.8	22.0	6.6	3.55	1.27
10	Assessment and grading methods are aligned well with simulated learning activities.	27.1	40.3	11.0	12.5	9.2	3.64	1.25

Table 2 presents teachers' perceptions of various challenges associated with simulated learning, with Mean scores and Standard Deviations (SD) providing additional insights into the extent of agreement and variability among teachers. Overall, there is a general consensus among teachers regarding the significance of these challenges. For instance, simulated learning platforms being complex to set up and operate effectively is perceived as a major challenge, with a relatively high Mean score of 3.93 and a relatively low Standard Deviation of 1.19, indicating strong agreement among teachers.

Figure 3

The challenges faced by the teachers in using simulated learning in their instruction



Relationship between Simulated Learning and Students' Academic Performance

The researcher attempted to find correlation between teachers' perceived simulated learning and their perceived effect on students' academic performance. For this purpose, Pearson's R correlation test was applied. The results are shown in the Table 4.3.

Table 3

Correlation between simulated learning and students' academic performance

Variable		ESP	ASL
ESP	Pearson Correlation	1	0.82**
	Sig. (2-tailed)		0.00
	N	273	273
ASL	Pearson Correlation	0.82**	1
	Sig. (2-tailed)	0.00	
	N	273	273

Table 3 illustrates the correlation between the "Effect of Simulated Learning on Students' Performance" (ESP) and the "Advantages of Simulated Learning" (ASL). These variables aim to measure the impact of simulated learning on students' academic performance. It displays Pearson correlation coefficients, significance values (Sig.), and the number of observations (N).

The Pearson correlation coefficient between ESP and ASL is exceptionally strong, with a value of 0.82. This high positive correlation suggests a robust and positive relationship between the perceived effect of simulated learning on students' performance and the perceived advantages of simulated learning. In this case, the positive value of 0.82 suggests that as the perceived effect on performance increases, there is a strong tendency for the perceived advantages of simulated learning to also increase.

The significance level (Sig.) of 0.00, which is less than the conventional threshold of 0.05, indicates that the observed correlation is statistically significant. In other words, there is a very low probability (approaching zero) that this observed correlation occurred by chance. This strengthens the confidence in the reliability of the correlation observed between ESP and ASL. The number of observations (N) for both variables is 273, indicating a consistent sample size for both ESP and ASL assessments.

Findings showed a highly significant and positive correlation (0.82) between the perceived effect of simulated learning on students' performance and the perceived advantages of simulated learning. This suggests that individuals who perceive simulated learning as having a positive impact on academic performance are also likely to recognize and appreciate the advantages associated with simulated learning. The findings imply a strong association between the perceived effectiveness of simulated learning and the perceived benefits it offers in educational settings.

Difference of Teachers' Perceived Use of Simulated Learning

This section analyzes the difference in teachers' perceived use of simulated learning on the basis of gender, age, sector, location, academic qualification, professional qualification and teaching experience.

Table 4

Gender-based difference in teachers' perception of effects, advantages, and challenges of simulated learning.

Variable	Group	N	Mean	SD	Df	t-value	p-value
ESP	Male	146	35.36	7.97	271	0.29	0.76
	Female	127	35.09	7.20			
ASL	Male	146	88.33	88.33	271	0.26	0.79
	Female	127	87.82	87.82			
CHSL	Male	146	35.36	35.36	271	0.31	0.75
	Female	127	35.07	35.07			

In all cases, the non-significant p-values indicate that there is no statistically significant difference between the male and female groups for each variable, suggesting that gender does not have a significant impact on the studied variables (ESP, ASL, and CHSL) based on the sample data provided.

Table 5

Sector-based difference of teachers' perception of effects, advantages and challenges of simulated learning.

Variable	Group	N	Mean	SD	Df	t-value	p-value
ESP	Public Private	132 141	35.53 34.97	7.84 7.41	271	.60	.54
ASL	Public	132	88.81	16.97	271	0.70	.48
	Private	141	87.43	15.32			
CHSL	Public	132	35.51	7.85	271	.58	.55
	Private	141	34.97	7.41			

Overall, the results suggest that there is no significant variation in the mean scores of ESP, ASL, and CHSL between the Public and Private groups, as indicated by the non-significant p-values across all variables.

Table 6

Location-based difference of teachers' perception of effects, advantages and challenges of simulated learning,

Variable	Group	N	Mean	SD	df	t-value	p-value
ESP	Urban	136	34.94	7.83	271	-.64	.51
	Rural	137	35.54	7.40			

ASL	Urban	136	87.58	15.71	271	-.52	.59
	Rural	137	88.61	16.56			
CHSL	Urban	136	34.92	7.84	271	-.66	.50
	Rural	137	35.54	7.40			

The non-significant p-values across all variables suggest that there is no substantial difference in the mean scores of ESP, ASL, and CHSL between Urban and Rural settings.

Table 7

Age-based difference of teachers' perception of effects, advantages and challenges of simulated learning,

Variable		Sum of Squares	df	Mean Square	F	Sig.
ESP	Between Groups	63.49	3	21.16	.362	.780
	Within Groups	15708.54	269	58.39		
ASL	Between Groups	147.31	3	49.10	.187	.905
	Within Groups	70599.01	269	262.45		
CHSL	Between Groups	64.49	3	21.49	.368	.776
	Within Groups	15732.50	269	58.48		

For all three variables (ESP, ASL, and CHSL), the non-significant p-values in the ANOVA results suggest that there are no significant differences in mean scores between the groups being compared.

Table 8

Academic qualification-based difference of teachers' perception of effects, advantages and challenges of simulated learning,

Variable		Sum of Squares	df	Mean Square	F	Sig.
ESP	Between Groups	63.49	7.872	3	.045	.987
	Within Groups	15708.54	15764.172	269		
ASL	Between Groups	166.959	3	55.653	.212	.888
	Within Groups	70579.371	269	262.377		
CHSL	Between Groups	9.074	3	3.025	.052	.985
	Within Groups	15787.922	269	58.691		

For all three variables (ESP, ASL, and CHSL), the non-significant p-values in the ANOVA results suggest that there are no significant differences in mean scores between the groups being compared.

Table 9

Professional Qualification-based difference of teachers' perception of effects, advantages and challenges of simulated learning,

Variable	Group	N	Mean	SD	df	t-value	p-value
ESP	B.Ed	117	35.72	7.39	271	.911	.363
	M.Ed	156	34.87	7.78			
ASL	B.Ed	117	89.70	15.00	271	1.432	.153
	M.Ed	156	86.89	16.86			
CHSL	B.Ed	117	35.72	7.39	271	.924	.356
	M.Ed	156	34.86	7.79			

The non-significant p-values across all variables suggest that there is no significant difference in the mean scores of ESP, ASL, and CHSL between participants with a B.Ed and those with an M.Ed.

Table 10

Experience-based difference of teachers' perception of effects, advantages and challenges of simulated learning,

Variable		Sum of Squares	df	Mean Square	F	Sig.
ESP	Between Groups	169.379	3	56.460	.973	.406
	Within Groups	15602.665	269	58.002		
ASL	Between Groups	1668.347	3	556.116	2.166	.092
	Within Groups	69077.983	269	256.795		
CHSL	Between Groups	171.249	3	57.083	.983	.401
	Within Groups	15625.747	269	58.088		

For the ESP and CHSL variables, there are no statistically significant differences in mean scores between groups. For the ASL variable, there is a borderline significant difference, and further investigation or replication may be warranted to confirm the findings.

Findings

The study investigated the impact of simulated learning on teachers and students, uncovering several noteworthy findings. In terms of demographic information, the sample exhibited a slight male skew, with the majority falling within the 31-40 age brackets and a balanced representation between public and private sectors. Both urban and rural locations were equally represented, and a varied distribution of academic and professional qualifications was observed. Notably, there was no significant variation in perception between public and private groups, urban and rural settings, or between different academic qualifications. Despite acknowledged challenges, there remained a positive inclination towards simulated learning, with a uniform perception of effectiveness across various groups.

Despite the diverse backgrounds, teachers generally held positive views on simulated learning, emphasizing its efficacy in understanding complex concepts, motivating students, and facilitating the practical application of theoretical knowledge. Notably, a strong correlation (0.82) emerged between teachers' perceived impact on students' performance and the recognized advantages of simulated learning, with statistical significance underscoring the reliability of this association. The study identified a strong positive correlation between the perceived effect of simulated learning on students' performance and the recognized advantages of simulated learning. Moreover, gender-based and group comparisons revealed no statistically significant differences in mean scores for the effects of simulated learning on students' performance (ESP), advantages of simulated learning (ASL), and challenges of simulated learning (CHSL)between various demographic and professional groups.

Challenges were acknowledged, particularly regarding the perceived complexity of technology implementation and concerns about resource availability. However, the study highlighted a nuanced perspective, revealing a favourable attitude towards simulated learning's potential benefits despite identified challenges. Importantly, statistical analyses, including t-tests and ANOVA, consistently indicated non-significant differences in mean scores across various demographic and professional groups, affirming a uniform perception of simulated learning effectiveness among the surveyed participants. Overall, the study's findings suggest a positive inclination towards the integration of simulated learning in education, emphasizing its multifaceted impact on teaching and learning processes.

Conclusion

Overall, the study provided valuable insights into the positive perception of simulated learning, offering guidance for educators, policymakers, and researchers interested in its integration into educational settings. It underscored both the potential benefits and challenges associated with the use of simulated learning for improving students' academic achievements in the subject of science at the elementary level. Teachers generally expressed positive views on simulated learning, particularly regarding its effectiveness in facilitating the understanding of complex concepts and engaging students. Positive sentiments were also observed regarding the impact of simulated learning on critical thinking skills, academic performance, and the overall learning experience. However, challenges highlighted by teachers included the perceived complexity of setting up and operating simulated learning platforms and insufficient access to technology and resources.

Suggestions for Future Research

The following suggestions are made based on the findings and conclusion of the study for the future researchers:

1. Conduct longitudinal studies to explore the sustained impact of simulated learning on students' academic performance over an extended period. This would provide insights into the long-term effectiveness and potential benefits of incorporating simulated learning in educational settings.
2. This study used a descriptive quantitative research design. It is suggested that experimental or quasi-experimental research design be used to get a more realistic picture.
3. Conduct in-depth studies on the impact of simulated learning within specific subjects or disciplines.

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