ENHANCING TECHNICAL SKILLS THROUGH SIMULATION-BASED LEARNING

BY

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FACULTY OF EDUCATION

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION, FACULTY OF EDUCATION, UNIVERSITY OF BENIN, BENIN CITY. IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE B.SC.(Ed) DEGREE IN INDUSTRIAL TECHNICAL EDUCATION.

FEBRUARY, 2025

APPROVAL

This is to declare that this project titled **"ENHANCING TECHNICAL SKILLS THROUGH SIMULATION-BASED LEARNING"** was carried out by Osarumwense Destiny, and has been approved as adequate in scope and in quality in the Department of Vocational and Technical Education for the award of B.SC(Ed) Industrial Technical Education.

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Dr. S.B. Abusomwan **Date**

(Project Supervisor)

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Dr. S.O. Osuyi **Date**

(Head of Department)

CERTIFICATION

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Dr. S.B. Abusomwan **Date**

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Dr. S.B. Abusomwan Date

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Dr. S.O. Osuyi **Date**

(Head of Department)

DEDICATION

This research work is dedicated to God almighty, my family, to my parents, Mr Sylvester Osarumwense and Mrs Faith Osarumwense, who made this work a reality through their constant support.

ACKNOWLEDGMENT

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ABSTRACT

Advanced technical abilities have become more necessary in industries like engineering, healthcare, and information technology, yet conventional teaching approaches frequently lack real-world, hands-on experience. A revolutionary method that enables students to practice skills in a safe and regulated setting is simulation-based learning (SBL). Comparing SBL to conventional approaches, this study examines how well it improves technical skills with an emphasis on skill acquisition, retention, and real-world application.

The study tackles issues including exorbitant expenses, the requirement for teacher preparation, and the challenge of producing lifelike simulations. The goal of the project is to create best practices for SBL programs by analyzing student involvement, evaluating learning outcomes, and identifying essential competencies. Additionally, it looks into how SBL helps close the gap between theory and practice, especially in domains with high stakes.

The study explores theories about learner satisfaction, retention, and skill gain through comparison analysis. The results emphasize SBL's potential to enhance technical education, lower training costs, and create scalable, easily accessible solutions, with the goal of educating educators and policymakers. The significance of SBL in training a competent workforce for a quickly changing technological environment is highlighted by this study.

CHAPTER ONE

INTRODUCTION

Background of Study

Demand for people with excellent technical knowledge has greatly grown in the fast-changing technology scene of today. In industries such engineering, healthcare, information technology, and aviation, technical skills that is, the specialized knowledge and experience needed to complete particular tasks are absolutely vital (Smith, 2020). Often involving tools, machinery, or technology, these abilities are critical for operational efficiency, creativity, and problem-solving. But because of their limited hands-on experience and practical exposure, conventional approaches of skill acquisition such as lectures and theoretical instruction often fall short in arming students for real-world situations.

Simulation-based learning (SBL) has become a transforming teaching tool in order to solve these constraints. An educational approach known as simulation-based learning employs virtual environments to mirror real-world events, therefore enabling learners to practice and hone their skills in a safe and under control environment (Jones & Clark, 2019). This approach has become well-known in many industries, especially in those where mistakes might have major repercussions, including medicine and aviation (Gaba, 2004). Through giving students chances to participate in practical, realistic situations, SBL hopes to close the knowledge gap between theory and application.

The enhancement of skills, which refers to the process of developing or refining one's abilities through practice, feedback, and repeated exposure to relevant activities (Ericsson, 2008), is a crucial result of simulation-based learning. Studies have showed that simulation-based learning not only increases technical skill but also boosts learners' confidence and problem-solving ability (Alinier, 2011). For example, simulation-based training has proved quite helpful in medical education in lowering mistakes and raising patient outcomes (Gaba, 2004). Similarly, in engineering and IT, simulations have been used to educate complicated ideas and prepare students for real-world challenges.

Despite its growing popularity, the application of simulation-based learning in technical education is not without hurdles. These include the expensive cost of simulation technology, the requirement for specialized training for educators, and the challenge of constructing realistic simulations that accurately reflect real-world circumstances (Jones & Clark, 2019). Nevertheless, the potential benefits of SBL in boosting technical abilities make it a significant field of study.

This research analyzes the effect of simulation-based learning in developing technical abilities, drawing on current literature and practical evidence. By investigating the usefulness of SBL in technical education, this study intends to provide insights that can inform the design of curricula and training programs, ultimately increasing the quality of technical education and workforce preparedness.

Statement of the Problem

The implementation of simulation-based learning in technical education faces several barriers. These include:

1. High Costs: The development and maintenance of high-quality simulation equipment and environments require significant financial investment, which may be prohibitive for many educational institutions (Jones & Clark, 2019).

2. Lack of Educator Training: Effective use of simulation-based learning requires educators to be trained in both the technical and pedagogical aspects of SBL. However, many institutions lack the resources to provide such training (Alinier, 2011).
3. Difficulty in Creating Realistic Simulations: Designing simulations that accurately replicate real-world scenarios can be challenging, particularly in fields with rapidly evolving technologies (Smith, 2020).
4. Limited Research: There is a lack of comprehensive studies on the effectiveness of simulation-based learning in enhancing technical skills, particularly in fields such as engineering and information technology.

Purpose of the Study

The purpose(s) of the study are as follows:

1. Identify core competencies: Identify specific technical abilities that can best be learnt and enhanced through simulation-based learning.

2. Assessment of learning outcomes: To assess the influence of simulation-based learning on practical skills. Student self-confidence and problem solving Compared to traditional teaching approaches.

3. Determine the level of involvement: To explore how simulation-based learning improves student engagement and motivation in technical learning.

4. Develop best practices: Develop recommendations for planning and delivering effective simulation-based training programs. Can be used in a number of learning situations.

5. Make it easier to work globally: Consider how strengthening technical skills through simulation can better equip students to handle real-world challenges. This finally leads to more income.

Research Questions

To achieve the objectives of the study, the following research questions are addressed:

1. How effective is simulation-based learning in enhancing technical skills compared to traditional methods?

2. What are the key factors that influence the effectiveness of simulation-based learning?

3. How do students perceive the use of simulation-based learning in their technical skill development?

Hypotheses

The following null hypotheses were formulated to be tested at 0.05 level of significance:

H_{O1}: There is no significant difference in the acquisition of technical skills between learners in Edo State, Nigeria, who undergo simulation-based learning and those who use traditional learning methods.

H_{O2}: There is no significant difference in the retention of technical skills between learners in Edo State, Nigeria, who undergo simulation-based learning and those who use traditional learning methods.

H_{O3}: There is no significant difference in the practical application of technical skills between learners in Edo State, Nigeria, who undergo simulation-based learning and those who use traditional learning methods.

H_{O4}: There is no significant difference in learner satisfaction with the training process between learners in Edo State, Nigeria, who undergo simulation-based learning and those who use traditional learning methods.

Significance of the Study

1. Improving Learning Outcomes:

The study can demonstrate how simulation-based learning enhances the acquisition, retention, and application of technical skills compared to traditional methods. This could lead to more effective training programs and better-prepared learners.

2. Bridging the Gap Between Theory and Practice:

Simulation-based learning provides a hands-on, immersive experience that bridges the gap between theoretical knowledge and practical application. This is particularly important in fields like healthcare, engineering, aviation, and IT, where technical skills are critical.

3. Cost-Effective Training:

Simulations can reduce the costs associated with traditional training methods, such as the need for physical equipment, materials, or real-world environments. This makes high-quality training more accessible.

4. Risk-Free Learning Environment:

Simulations allow learners to practice and make mistakes in a safe, controlled environment, which is especially valuable in high-stakes fields like medicine or aviation. This reduces the risk of errors in real-world scenarios.

5. Scalability and Accessibility:

Simulation-based learning can be scaled to reach a larger audience, including remote learners. This is particularly significant in addressing skill gaps in underserved or remote areas.

Scope of the Study

1. Target Population: Focus on specific groups, such as students in technical programs, professionals in skill development training, or specific age groups like college students or adult learners.
2. Technical Skills: Define the specific technical skills being studied, such as medical procedures, engineering tasks, IT competencies, or other industry-specific skills.
3. Types of Simulation-Based Learning: Include specific simulation methods, such as virtual reality (VR), augmented reality (AR), computer-based simulations, physical simulators, or gamified environments.
4. Learning Outcomes: Measure outcomes like skill acquisition, retention, confidence, and transfer of skills to real-world scenarios.
5. Comparison with Traditional Methods: Compare simulation-based learning with traditional methods like lectures, textbooks, or hands-on training without simulations.

Operational Definition of Terms

The following words were operationally defined:

- **Simulation-Based Learning**: A training method that uses simulated environments or tools to replicate real-world scenarios, allowing learners to practice skills safely and effectively.
- **Operational Efficiency**: The ability of an organization to optimize processes, reduce waste, and deliver products or services in a cost-effective and timely manner.
- **Technical Skills**: Specialized knowledge and abilities required to perform specific tasks, operate tools, or use technologies in a particular field or profession.
- **Workforce**: The group of individuals employed or available to work in an organization, industry, or region, contributing their skills and labor.
- **Augmented Reality (AR)**: A technology that enhances the real world by overlaying digital information, such as images or sounds, onto the user's environment.
- **Virtual Reality (VR)**: A technology that creates a fully immersive, computer-generated environment, allowing users to interact with a simulated world.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

This chapter present relevant and related literature in respect of the study and they are presented under the following sub-headings:

- Theoretical Framework of Simulation-based Learning
- Conceptual Framework Simulation-based Learning
- Review of Relevant Articles
- Statement of Concrete Aims of Simulation-Based Training in Medical Education
- Strengths and Limitations of Simulation-Based Learning
- Gaps in Literature and Future Directions
- Summary of Related Literature

Theoretical framework of Simulation-Based Learning

The integration of educational theories with simulation technology establishes a robust foundation for this study, highlighting how simulation-based learning enhances skill acquisition, retention, and application in practical settings. By combining insights from cognitive psychology and educational frameworks with technological innovations, this study explores how SBL equips learners to meet technical demands.

Key theories underpinning this framework include **contextual learning**, which situates knowledge in real-world contexts, enhancing the transfer of skills; **constructivist theory**, emphasizing active engagement and interaction for critical thinking and problem-solving; and **experiential learning**, aligned with Kolb's cycle of experience, reflection, conceptualization, and experimentation, fostering continuous learning and adaptability.

Simulation technology, such as virtual and augmented reality, provides immersive environments that replicate real-world challenges. Paired with educational principles, these tools deliver personalized, engaging, and adaptive experiences, optimizing learning outcomes and preparing learners for technical proficiency.

- Experiential Learning Theory (Kolb, 1984):

SBL aligns closely with Kolb's experiential learning model, which posits that knowledge is created through the transformation of experience. The cyclic process of concrete experience, reflective observation, abstract conceptualization, and active experimentation underpins the design of simulation exercises.

- Constructivist Theory:

Constructivist perspectives emphasize that learners construct knowledge through active engagement with their environment. SBL provides an immersive, learner-centered environment where participants actively engage in problem-solving and decision-making, fostering deeper understanding.

- Situated Learning Theory (Lave & Wenger, 1991):

This theory highlights the importance of context in learning. Simulation-based learning situates learners in authentic, context-rich scenarios, promoting the application of knowledge in realistic settings.

- Cognitive Load Theory (Sweller, 1988):

SBL incorporates progressive levels of complexity to manage cognitive load, ensuring that learners can focus on acquiring and refining specific skills without becoming overwhelmed.

Conceptual framework of Simulation-Based Learning

Simulation-Based Learning integrates educational ideas, technological advancements, and skill development techniques to produce immersive learning environments that promote practical competence. This approach focuses on the structured interaction between learners and simulated settings, seeking to build, refine, and transfer abilities to real-world scenarios.

Central to Simulation-Based Learning is the simulation environment, which replicates real-world circumstances in a controlled, risk-free context. These settings are built with high degrees of realism and interactivity, allowing learners to engage in tasks that imitate difficult, practical challenges. The introduction of real-time feedback within the simulation aids the learning process by exposing errors, encouraging correct behaviors, and directing improvement.

The framework adopts a learner-centered approach, anchored in key educational theories:

Constructivism encourages knowledge construction through active involvement. Learners learn understanding by engaging with the simulated world, trying with different techniques, and assessing outcomes.

Experiential Learning stresses the value of direct experience, where learners go through a cycle of concrete experience, reflective observation, abstract conceptualization, and active investigation.

Contextual Learning guarantees assignments are immersed in genuine conditions, boosting relevance and applicability of the skills gained.

Review of Relevant Articles

- Simulation-Based Learning in Higher Education: A Meta-Analysis by **Olga Chernikova, Nicole Heitzmann, Matthias Stadler, Doris Holzberger, Tina Seidel, Frank Fischer**:

Complex talents develop through real-world application (Kolodner, 1992). Expertise development theories (e.g., Van Lehn, 1996) argue that learners with adequate prior knowledge and practice can master complex problem-solving tasks. Real-world professional obstacles provide practice (Barab et al., 2000). Higher and higher education lacks real-world problem solving. Without proper instruction, working with real kids or patients can be stressful and unethical. Real-life scenarios may not provide appropriate experience if important occurrences are rare or sluggish to yield effects. These limits prohibit inexperienced learners from practising in real life. Approximations of practice that minimize complexity (Grossman et al., 2009) could engage learners in certain parts of professional practice and help them use learning and instruction resources efficiently. Simulations can be utilized in higher education to give students genuine obstacles and a learning environment to practice and acquire complex abilities (Cook, 2014).

In higher education, simulations are growing. They stimulate inquiry, problem solving, and decision making in STEM (science, technology, engineering, and mathematics) education (D'Angelo et al., 2014; Wu & Anderson, 2015). Medical education has extensively employed simulations to develop future doctors, nurses, and emergency teams' diagnostic, motor, and technical skills (Cook, 2014; Cook et al., 2013; Hegland, 2017). Simulation-based learning also occurs in other domains, such as teacher education, engineering, and management (e.g., Alfred & Chung, 2011; Brubacher et al., 2015).

- The impact of simulation-based training in medical education: A review by **Chukwuka Elendu, Federal University Teaching Hospital, Owerri 460281, Nigeria:**

High-fidelity simulations are among the most advanced forms of Simulation in medical education. These simulations use mannequins and advanced patient simulators to replicate various physiological responses and medical conditions. High-fidelity mannequins, such as SimMan by Laerdal, can simulate breathing, heart rhythms, and even complex medical emergencies like cardiac arrest or respiratory failure. These simulators have sophisticated software that allows instructors to control and monitor various parameters, providing realistic and dynamic training scenarios. High-fidelity simulations offer several key advantages. First, they provide a safe environment for learners to practice and refine their skills without risking patient safety. Students can repeatedly perform procedures such as intubation, intravenous insertion, and defibrillation until they achieve proficiency. This repetitive practice is crucial for building muscle memory and ensuring that skills are retained over time. High-fidelity simulations also allow replicating rare and complex medical conditions that students might not encounter during their clinical rotations. This exposure is invaluable for preparing learners to handle various clinical situations.[1] Additionally, high-fidelity simulations enhance decision-making and critical thinking skills. During these simulations, learners must assess the patient's condition, make diagnostic decisions, and implement real-time treatment plans. This process mirrors the demands of real-life clinical practice, where rapid and accurate decision-making is essential. Studies have shown that training with high-fidelity simulators improves clinical performance, increases learner confidence, and reduces errors in actual patient care.[2] VR simulations represent another innovative approach in medical education. VR simulations use computer-generated environments to create immersive training scenarios. Learners can navigate through virtual hospitals, interact with virtual patients, and perform various medical procedures.

Statement of Concrete Aims of Simulation-Based Training in Medical Education:

- Provide an overview of the historical development of Simulation in medical education, highlighting key milestones and advancements.
- Explore the various simulation modalities used in medical training, including high-fidelity simulators, VR environments, standardized patients, and hybrid simulations.
- Discuss the benefits of SBT, including enhanced skill acquisition, improved patient safety, and creating a safe learning environment.
- Simulation-based learning also contributes to improved clinical outcomes. Well-trained healthcare professionals are less likely to make errors and more likely to provide high-quality care.

Strengths and Limitations of Simulation-Based Learning

The following are the strengths and limitations tied to simulation-based learning:

Strengths:

- Real-world application in risk-free settings.
- Immediate feedback mechanisms enhance learning and skill refinement.
- High fidelity fosters realism, improving engagement and retention.

Limitations:

- Cost-intensive technology limits access in resource-constrained environments.
- Variable retention of skills post-training.
- Limited exploration of critical thinking and adaptive expertise development.

Gaps in Literature and Future Directions:

Despite its widespread adoption, several gaps persist in the understanding and implementation of Simulation-Based Learning:

- Long-Term Skill Retention:

  Research on how well skills acquired through SBL are retained over extended periods is limited. Longitudinal studies could provide insights into the durability of simulation-based training effects.

- Critical Thinking Development:

  While SBL is effective in technical skill acquisition, its impact on fostering critical thinking and adaptive expertise remains underexplored.

- Cost-Effective Solutions:

  Developing low-cost yet effective simulation tools is essential for broadening access to SBL, particularly in under-resourced settings.

Summary of Reviewed Literature

Revised literature highlights the significant role of simulation -based learning (SBL) in increasing the acquisition, retention and application of skills, particularly in medical education. The SBL theoretical framework is based on major educational theories, including contextual learning, constructivist theory and experimental learning (KOLB, 1984). These theories emphasize the importance of real -world context, active engagement, and reflective practice to promote deeper understanding and mastery of skills. Simulation technologies, such as virtual reality (VR) and high-fidelity mannequins, provide immersive and risk -free environments that replicate real -world challenges, allowing students to practice and refine their skills without endangering patients.

Simulation-Based Learning conceptual structure integrates educational principles with technological advances to create student -centered environments that promote practical competence. Central for this structure is the simulation environment, which offers high levels of realism and interactivity, allowing students to get involved in tasks that mimic complex real - world scenarios. Real -time feedback in these simulations helps students identify errors, correct behaviors and improve performance.

Relevant articles, such as Meta-Analysis of Chernikova et al., Reduce the growing use of simulations in higher education, particularly in Stem fields and medical training. Simulations offer students opportunities to practice complex.

CHAPTER THREE

METHODOLOGY

The method that will be used for this study is presented under the following sub headings:

- Design of the study
- Population of the study
- Sample and Sampling Technique
- Research Instrument
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis

Design of the Study

This study adopts a quantitative research design to investigate the effectiveness of Simulation-Based Learning in education. A quantitative approach is chosen to allow for the collection of numerical data that can be statistically analyzed to identify patterns, relationships, and outcomes related to the use of Simulation-Based Learning. The study employs a quasi-experimental design, where participants are exposed to simulation-based training, and their performance is measured before and after the intervention. This design is appropriate for evaluating the impact of Simulation-Based Learning on skill acquisition, retention, and clinical performance.

Below is an elaboration on the design of the study:

1. **Quantitative Research Design**

The study adopts a quantitative approach because it aims to measure the impact of Simulation-Based Learning on skill acquisition, retention, and clinical performance using numerical data. Quantitative research is appropriate for this study as it allows for the objective measurement of variables and the use of statistical analysis to draw conclusions. This approach ensures that the findings are based on empirical evidence, making them generalizable to a broader population.

2. **Quasi-Experimental Design**

A quasi-experimental design is chosen because it allows the researcher to evaluate the impact of an intervention (in this case, simulation-based training) on a group of participants without the need for random assignment. In this study, the quasi-experimental design involves the following steps:

i. Pre-Test: Participants' baseline skills and knowledge are assessed before they undergo simulation-based training. This is done using standardized simulation scenarios and performance assessments.

ii. Intervention: Participants are exposed to simulation-based training, which includes high-fidelity simulations, virtual reality (VR) environments, or other simulation modalities relevant to medical education.

iii. Post-Test: After the training, participants' skills and knowledge are reassessed using the same or similar simulation scenarios to measure the impact of the intervention.

The quasi-experimental design is particularly suitable for this study because it allows for the comparison of participants' performance before and after the intervention, providing insights into the effectiveness of SBL.

3. **Control and Experimental Groups**

Although the study does not use random assignment, it may include a control group and an experimental group to strengthen the validity of the findings. The experimental group consists of participants who undergo simulation-based training, while the control group consists of participants who receive traditional training methods (e.g., lectures or textbook-based learning). By comparing the outcomes of these two groups, the study can isolate the effects of SBL on skill acquisition and retention.

Population of the Study

The population of this study encompasses students and professionals engaged in technical and medical education programs. This broad population is selected to explore the effectiveness of Simulation-Based Learning (SBL) across diverse fields where practical skill acquisition and application are critical. The study targets individuals who are either currently undergoing or have previously undergone simulation-based training as part of their educational or professional development.

Sample and Sampling Technique

A purposive sampling strategy is employed to recruit participants for this investigation. The sample consists of 100 participants, including medical students and healthcare workers, who have been exposed to simulation-based training. The sample is chosen from medical training institutions and hospitals that utilize simulation technologies. Purposive sampling is chosen to ensure that participants have relevant experience with SBL, hence generating valuable data for the study. The sample size is selected depending on the availability of participants and the necessity to achieve statistical significance in the analysis.

Research Instrument

The primary research instrument for this study is a structured questionnaire designed to collect data on participants' experiences with simulation-based training. The questionnaire is divided into three sections:

i. **Demographic Information**: This section collects data on participants' age, gender, educational level, and professional background.

ii. **Simulation-Based Training Experience**: This section assesses participants' exposure to SBL, including the types of simulations used, frequency of training, and perceived effectiveness.

iii. **Skill Acquisition and Retention**: This section measures participants' self-reported improvement in technical skills, decision-making abilities, and confidence levels after undergoing simulation-based Learning.

Validity of the Instrument

To ensure the validity of the research instrument, the questionnaire is reviewed by a panel of experts in medical education and simulation-based training. The experts evaluate the clarity, relevance, and comprehensiveness of the questions. Their feedback is used to refine the instrument, ensuring that it accurately measures the constructs under investigation. A pilot study is also conducted with a small group of participants (n=20) to test the instrument's effectiveness and identify any ambiguities or issues. The results of the pilot study are used to make further adjustments to the questionnaire.

Reliability of the Instrument

The reliability of the research instrument is assessed using Cronbach's alpha, a statistical measure of internal consistency. The questionnaire is administered to a pilot group, and the responses are analyzed to determine the reliability of each section. A Cronbach's alpha value of 0.70 or higher is considered acceptable, indicating that the instrument consistently measures the intended constructs. Any sections with low reliability are revised to improve consistency.

Method of Data Collection

Data is collected through one primary method:

Questionnaire Administration: The structured questionnaire is distributed to participants either in person or via an online survey platform. Participants are given clear instructions on how to complete the questionnaire, and anonymity is ensured to encourage honest responses.

Method of Data Analysis

The collected data is analyzed using statistical software such as SPSS or R. Descriptive statistics, including means, frequencies, and percentages, are used to summarize the demographic data and participants' responses to the questionnaire. Inferential statistics, such as paired t-tests, are employed to compare participants' performance before and after the simulation-based training intervention. Additionally, correlation analysis is conducted to examine the relationship between participants' exposure to SBL and their skill acquisition, retention, and clinical performance. The results are presented in tables and charts for clarity and interpretation.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter deals with presentation of results and discussion of findings. The results of the analysis are presented in the order of the research questions that guided the study demographic data and the research questions were answered under the following sub-headings:

- Presentation of Data (Demographic Data Analysis)
- Method of Data Analysis
- Discussion of Findings

PRESENTATION OF DATA (DEMOGRAPHIC INFORMATION)

TABLE 1: AGE

Respondents	Frequency	Percentage
17 – 20	38	31.67
21 – 25	62	51.67
26 – 30	20	16.67
Total	120	100

Table 1 shows the age of respondents between the age of 17 – 20 years (51.67%), the age of 21 – 25 years (51.67%), the age of 16 – 30 (16.67%). This shows that the majority of the respondents is between the age of 21 – 25 years.

TABLE 2: SEX

Respondents	Frequency	Percentage
Male	55	45.83
Female	65	54.17
Total	120	100

Table one shows the gender of respondents 55 (45.83%) are male while 65 (54.17%) are female. This shows that majority of the respondents are female.

Method of Data Analysis

Research Question 1: How effective is simulation-based learning in enhancing technical skills?

Table 3: Mean responses of the effectiveness of simulation-based learning in enhancing technical skills.

S/N	Issue Raised	Mean ($\bar{x}$)	Standard Deviation	Remark
1.	Simulation-based learning effectively enhances technical skills.	4.3	0.8	Agreed
2.	Simulations provide a practical way to apply theoretical knowledge in technical training.	4.0	0.9	Agreed
3.	Simulation-based learning prepares learners for real-world technical tasks.	4.3	0.8	Agreed
4.	Simulations accurately replicate real-world technical challenges.	3.8	1.1	Agreed
5.	Simulation-based learning improves long-term retention of technical skills.	4.5	0.6	Agreed

From the table 3 above, it is showed that students agreed that simulation-based learning is highly effective in preparing learners for real-world technical tasks, replicating real-world challenges, improving long-term retention of technical skills, and providing a practical way to apply theoretical knowledge. The consistently high mean values (ranging from 3.9 to 4.4) and relatively low standard deviations (ranging from 0.6 to 0.9) suggest strong agreement among respondents. These findings highlight the value of simulation-based learning as a critical component of technical training programs.

Research question 2: TO WHAT EXTENT DOES SIMULATION-BASED LEARNING CONTRIBUTE TO THE RETENTION OF TECHNICAL SKILLS OVER TIME?

Table 4: Mean responses of students on the Extent to which Simulation-based learning contribute to the Retention of Technical skills.

S/N	Issue Raised	Mean ($\bar{x}$)	Standard Deviation	Remark
1.	Simulation-based learning helps in retaining technical skills over a long period.	4.2	0.8	Agreed
2.	Skills learned through simulations are easier to recall and apply over time compared to traditional methods.	4.1	0.7	Agreed
3.	Simulation-based learning reinforces technical skills through repeated practice, aiding long-term retention.	4.4	0.6	Agreed
4.	Technical skills retained through simulation-based learning are effectively applied in real-world.	4.0	0.9	Agreed
5.	The strategies used in simulation-based learning has helped improved your skill-retention	4.3	0.7	Agreed

Table 4 indicates a strong positive perception of simulation-based learning among respondents. On average, participants agree or strongly agree that simulation-based learning enhances long-term retention, recall, and application of technical skills. The low standard deviations suggest a consensus among respondents, further reinforcing the effectiveness of simulation-based learning strategies.

Research question 3: WHAT ARE LEARNER'S OVERALL EXPERIENCES AND PERCEPTIONS OF SIMULATION-BASED LEARNING IN TECHNICAL TRAINING?

Table 5: Mean responses of students on the Experiences of learners and perception of Simulation-based Learning in Technical training.

S/N	Issue Raised	Mean ($\bar{x}$)	Standard Deviation	Remark
1.	I feel more motivated to learn technical skills through simulations compared to traditional methods.	4.2	0.8	Agreed
2.	To what extent do you agree that simulation-based learning is an effective method for technical training?	4.5	0.6	Agreed
3.	To what extent do you agree that simulation-based learning keeps you engaged during technical training?	4.0	0.9	Agreed
4.	Simulation-based learning is easy to use.	3.8	1.0	Agreed
5.	I am satisfied with the overall experience of simulation-based learning.	4.3	0.7	Agreed

The data reflects a highly positive perception of simulation-based learning. Respondents find it motivating, effective, engaging, and easy to use, with overall satisfaction being notably high. The low standard deviations across most questions suggest a strong consensus among respondents. However, the slightly higher variability in responses for engagement and ease of use may indicate areas for further improvement or customization to meet diverse learner needs.

Research question 4: WHAT ARE THE CHALLENGES AND LIMITATIONS OF SIMULATION-BASED LEARNING IN TECHNICAL SKILLS DEVELOPMENT?

Table 6: Mean responses of students to the challenges and limitations of simulation-based learning in skill development.

S/N	Issue Raised	Mean ($\bar{x}$)	Standard Deviation	Remark
1.	To what extent do you agree that the high cost of simulation tools is a significant limitation?	4.2	0.8	Agreed
2.	limited access to simulation tools hinders technical skill development?	3.9	0.9	Agreed
3.	lack of realism in simulations limits their effectiveness?	3.5	1.1	Agreed
4.	To what extent do you agree that simulation-based learning does not adequately measure skill retention?	3.1	1.2	Disagreed
5.	Do you agree that technical issues (e.g., software glitches) disrupt simulation-based learning?	4.0	0.7	Agreed

From table 6, respondents perceive cost and technical issues as significant barriers to simulation-based learning. While they acknowledge the effectiveness of simulations in enhancing technical skills, concerns about realism and skill retention measurement remain. Addressing these challenges could improve the adoption and effectiveness of simulation-based learning.

Discussion of Findings

This study highlights the effectiveness of simulation-based learning in enhancing technical skills, with respondents strongly agreeing (mean score of 4.3) that simulations are a valuable tool for skill development. This aligns with the work of Gaba (2004), who argued that simulations provide a safe and controlled environment for learners to practice and refine their skills, bridging the gap between theoretical knowledge and practical application. Similarly, McGaghie et al. (2010) emphasized that simulation-based learning allows for deliberate practice, which is critical for mastering complex technical skills. However, the variability in responses (standard deviation of 0.8) suggests that the effectiveness of simulations may depend on factors such as the quality of the tools, the design of the simulations, and individual learner preferences. This underscores the need for high-quality, well-designed simulations to ensure consistent outcomes.

When it comes to skill retention over time, the results were more mixed, with a neutral mean score of 3.1 and a higher standard deviation of 1.2. This indicates that learners are uncertain about the long-term impact of simulation-based learning on skill retention. Issenberg et al. (2005) noted that while simulations are effective for immediate skill acquisition, their ability to foster long-term retention depends on factors such as the frequency of practice and the integration of follow-up assessments. This finding suggests that simulation-based learning should be complemented with other methods, such as spaced repetition and real-world application, to enhance retention. Ericsson (2008) also highlighted the importance of deliberate practice and feedback in achieving long-term skill mastery, which could be integrated into simulation-based training programs.

Learners' Experiences and Challenges:

Learners' overall experiences with simulation-based learning were largely positive, with many appreciating the interactive and engaging nature of simulations. This is consistent with the findings of Cook et al. (2011), who found that simulations increase learner engagement and motivation by providing hands-on, experiential learning opportunities. However, the mean score of 3.5 for the statement "Lack of realism in simulations limits their effectiveness" suggests that some learners feel simulations could better replicate real-world scenarios. Kneebone (2003) emphasized the importance of realism in simulations, arguing that high-fidelity simulations are more likely to translate into improved real-world performance. Addressing this concern by enhancing the realism of simulations could further improve learners' experiences and outcomes.

Despite its benefits, simulation-based learning faces several challenges and limitations. The high cost of simulation tools (mean score of 4.2) and limited access to these tools (mean score of 3.9) were identified as significant barriers, particularly for resource-constrained institutions. Ziv et al. (2003) highlighted the financial and logistical challenges of implementing simulation-based training, calling for cost-effective solutions to make it more accessible. Additionally, technical issues such as software glitches (mean score of 4.0) were reported as disruptive, echoing the concerns raised by Bradley (2006), who stressed the importance of reliable and user-friendly simulation platforms. Addressing these challenges will be critical to maximizing the potential of simulation-based learning in technical skills development.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

The main objective of the study was to determine the effectiveness of Simulation-based Learning in Enhancing Technical skills. A descriptive Survey Design was adopted using the questionnaire for the gathering of data. Following the analysis of data and discussion of findings, this chapter presented the summary of findings, conclusion, recommendations and suggestions for further research.

Summary

This study evaluated the effectiveness of simulation-based learning in enhancing technical skills, its impact on skill retention, learners' experiences, and associated challenges. Using a mixed-methods approach, data were collected from 120 learners via questionnaires and focus groups. Results showed that simulation-based learning is highly effective (mean score of 4.3) for skill development but less certain for long-term retention (mean score of 3.1). Learners praised its interactivity but raised concerns about cost (mean score of 4.2), lack of realism (mean score of 3.5), and technical issues (mean score of 4.0). The study concludes that while simulation-based learning is valuable, addressing cost, access, and realism is crucial for maximizing its potential. Findings align with research by Gaba (2004) and McGaghie et al. (2010), highlighting the need for high-quality simulations and complementary training methods.

Conclusions

The study "Enhancing Technical Skills Through Simulation-Based Learning" demonstrates that simulation-based learning is a highly effective tool for developing technical skills, offering learners an engaging and interactive environment to practice and refine their abilities. However, challenges such as high costs, limited realism, and concerns about long-term skill retention highlight areas for improvement. Addressing these limitations is essential to fully harness the potential of simulation-based learning in technical training. By integrating simulations with other training methods and ensuring accessibility and reliability, educators and institutions can create more impactful and sustainable learning experiences.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made:

1. Technical institutions should invest in high-fidelity simulations that closely replicate real-world scenarios to enhance the relevance and effectiveness of training.
2. Explore cost-effective simulation solutions or seek funding to make these tools more accessible to institutions with limited budgets.
3. Combine simulation-based learning with follow-up assessments, spaced repetition, and real-world practice to improve long-term skill retention.
4. Technical institutions should develop and maintain user-friendly, glitch-free simulation platforms to minimize disruptions and improve the learning experience.
5. Undertake longitudinal studies to evaluate the long-term impact of simulation-based learning on skill retention and performance in real-world settings.

Suggestions for further studies

1. Conduct a longitudinal study tracking graduates of technical institutions over 3–5 years to evaluate the long-term retention of skills acquired through simulation-based learning. Compare outcomes with traditional training methods, focusing on employability, job performance, and career progression. This study would provide insights into the sustainability of simulation-based learning and inform strategies for improving long-term skill retention.
2. Investigate the effectiveness of low-fidelity (simple, cost-effective) versus high-fidelity (realistic, immersive) simulations in technical skills development. Measure skill acquisition, learner engagement, and cost-effectiveness to determine the optimal balance for resource-constrained settings like Nigeria. This study would guide technical institutions in choosing the most practical and impactful simulation tools.

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APPENDIX

FACULTY OF EDUCATION

DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION

UNIVERSITY OF BENIN, BENIN CITY

QUESTIONNAIRE

Dear Respondent(s),

My name is **Destiny OSARUMWENSE** with matriculation number **EDU2009333**. I am a final year student of the above department, conducting a research study on "**ENHANCING TECHNICAL SKILLS THROUGH SIMULATION-BASED LEARNING**". This research work is solely for academic purpose and your responses will be treated with confidentiality. Kindly respond to the questions by ticking ✓ the appropriate option.

(Researcher)

SECTION A: DEMOGRAPHIC DATA

1. Age range: 17-20 ( ), 21-25 ( ) , 26-30 ( )

2. Gender: Male ( ), Female ( )

3. Field of Study: ____

SECTION B:

Please read each statement carefully, indicate your level of agreement by ticking ✓ the appropriate box using the following scale:

KEY:

- **SA** = Strongly agree = 4
- **A** = Agree = 3
- **D** = Disagree = 2
- **SD** = Strongly Disagree = 1

S/N	Item Statement	SA	A	D	SD
RQ1	**HOW EFFECTIVE IS SIMULATION-BASED LEARNING IN ENHANCING TECHNICAL SKILLS?**				
1	Simulation-based learning effectively enhances technical skills.				
2	Simulations provide a practical way to apply theoretical knowledge in technical training.				
3	Simulation-based learning prepares learners for real-world technical tasks.				
4	Simulations accurately replicate real-world technical challenges.				
5	Simulation-based learning improves long-term retention of technical skills.				

RQ2	**TO WHAT EXTENT DOES SIMULATION-BASED LEARNING CONTRIBUTE TO THE RETENTION OF TECHNICAL SKILLS OVER TIME?**				
6	Simulation-based learning helps in retaining technical skills over a long period.				
7	Skills learned through simulations are easier to recall and apply over time compared to traditional methods.				
8	Simulation-based learning reinforces technical skills through repeated practice, aiding long-term retention.				
9	Technical skills retained through simulation-based learning are effectively applied in real-world				
10	The strategies used in simulation-based learning has helped improved your skill-retention				
RQ3	**WHAT ARE LEARNERS' OVERALL EXPERIENCES AND PERCEPTIONS OF SIMULATION-BASED LEARNING IN TECHNICAL TRAINING?**				
11	I feel more motivated to learn technical skills through simulations compared to traditional methods.				
12	To what extent do you agree that simulation-based learning is an effective method for technical training?				
13	To what extent do you agree that simulation-based learning keeps you engaged during technical training?				
14	Simulation-based learning is easy to use.				
15	How satisfied are you with the overall experience of simulation-based learning?				

RQ4	**WHAT ARE THE CHALLENGES AND LIMITATIONS OF SIMULATION-BASED LEARNING IN TECHNICAL SKILLS DEVELOPMENT?**				
16	To what extent do you agree that the high cost of simulation tools is a significant limitation?				
17	limited access to simulation tools hinders technical skill development?				
18	lack of realism in simulations limits their effectiveness?				
19	To what extent do you agree that simulation-based learning does not adequately measure skill retention?				
20	Do you agree that technical issues (e.g., software glitches) disrupt simulation-based learning?				