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Enhancing Process Comprehension through Simulation-Based Learning

Prity Choudhary[1] and Vikas Jalan[2]
University of Tampa, Florida, USA[1]
Visvesvaraya Technological University, India[2]

Abstract*: This simulation-based learning research purports to explain how to improve process understanding and learner confidence in corporate training. Feedback through survey questionnaires and interviews was sought from approximately 150 participants, and a large proportion of those expressed a high degree of confidence and satisfaction with the simulation as a practical learning tool. Some key components contributing to such understanding included step-by-step guidance, realistic screen layout, and interactive engagement. The minor challenges included technical glitches and a need for more clarity in some instructions. The improvements suggested for future learning included the addition of detailed instructions, various scenarios, and summary reviews. This study offers valuable lessons on simulation-based learning. However, the findings are couched in a very limited reliance on self-reported data and a failure to assess long-term impact. Regardless, this research reiterates the great potential of simulations in interposing the gap between theory and practice. It also suggests that further studies concerning long-term knowledge retention, advanced technologies, scalability, and personalised learning are necessary to optimise their effectiveness.*

Keywords: Simulation-Based Learning, Process understanding, training, interactive learning tools, real-life applications, Instructional Design, Knowledge Retention, Personalized Learning, Advanced technologies, Effective Training

I. PURPOSE OF STUDY

The research seeks to investigate how simulation-based learning enriches learners' understanding of the complex processes involved in most fields. The study also analyses how simulations bridge the gap between the theoretical and practical aspects of knowledge, proving that simulations are among the most potent tools in instructional activities. The study endeavours to provide instructional designers with evidence-based insights into the value addition that simulations bring into learning programs. It also attempts to determine the best practices in designing and delivering practical simulations that assure optimal engagement, retention, and mastery of skills. The goal is to contribute to instructional design by proposing strategies to enhance process-oriented training to empower learners to achieve excellent proficiency levels and confidence in applying skills in real-life situations. Problem Statement

In today's fast-changing educational and corporate training environments, learners increasingly have to be taught complex processes that they will apply efficiently. Typically, traditional methods of knowledge transfer, such as lecture-based dissemination of textual or printed material or passive web-based e-learning models, are particularly ineffective for such specific complex procedural knowledge. Therefore, many learners fail to make the connection between the practical application of the theoretical concepts once done, and this usually develops a gap between what is learned and what is done practically. It is most jarring in professions that require time on task and vehicle and procedure mastery, including healthcare delivery, engineering, and business management. As a result of not being able to scenario plan and perform practices with these processes, learners may not only be insecure in their abilities but also lack the proper skills required to perform processes correctly.

This is where simulation-based learning is useful since it creates realistic learning experiences in which learners can explore, get different opportunities to solve problems and apply what they learned. Nevertheless, the discussed use of simulations in the overall concept of instructional design poses certain difficulties regarding costs, access to simulations, and feasible real-life problem-solving practices. This research provides a counterbalance to such

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challenges by assessing the impact of simulation-based learning on process comprehension and determining the best practices that instructional designers can use to exploit simulations effectively in improving learner outcomes.

A. Research Question

How does simulation-based learning improve comprehension and retention of complex processes compared to traditional methods?

II. INTRODUCTION

Technology's fast pace and impact have considerably changed corporate and educational settings.

Instructional design has gradually shifted from static methods of lectures and printed materials to dynamically adapting to the modern learner's needs. Organisations and educational institutions recognise that there is a need for the adoption of more dynamic and engaging methods of learning. With the world's constant acceleration of pace, there is an acute and continuing need for training methodologies that provide knowledge and actively involve the learner in complex conceptual development with skills to apply such knowledge in context (Teasdale et al., 2016). There is an observable shift in the instructional design with increasing emphasis on using interactive mediums such as simulations in an apposite training process. These simulations create a virtual scenario that enables one to model real-life situations, make decisions, and assess the outcome of decisions without the repercussions arising from the actual decision made. This knowledge does not only accumulate into one's store of intellectual capital but translates into problem-solving and thinking. Using prototypes to mimic complex processes and systems becomes more relevant as industries develop and become more complex so that learners can grasp processes and their interactions (Tremblay et al., 2019).

Simulation-based learning is essential in fields where complex processes are to be mastered. Across the contextual domain of work, including business or healthcare, simulations enable learners to improve their competencies in real-life tasks within the safe space of the simulation environment. In this context, constructionist understanding of process comprehension as advanced through simulation-based learning is emerging even more as the key driver of mastering and redesigning various processes. This enables the learners to practice what they learned through simulations, thus achieving deeper and longer learning of the subject matter (Campos et al., 2020). The growing popularity of simulations as a 'useful' learning tool has fueled the rising interest in understanding how to best design and deliver these experiences for maximum learning outcomes. This paper aims to find out how simulation can help in increasing understanding of the process and brings information about the principles and methodological approaches to increase the efficiency of learning by simulation (Melo et al., 2018).

III. LITERATURE REVIEW

CS-based learning has been around since the early twentieth century when education and training happened with the use of role-play and modelling that was used in military training and exercises. Modern simulation started in the 1960s with computer technology, where early computer-based simulation started appearing (Miller, 2016). Most of these simulations are somewhat simple in structure and allow the learners to solve problems and make decisions within a controlled environment; however, in recent years, they have become complex and sophisticated systems, embracing fully immersive technologies such as virtual and augmented reality for enhanced learning experiences. These technologies allow for realistic and interactive environments that enhance learning experiences, thereby allowing the simulation of complex processes that were previously unimaginable (Kadi & Satori, 2019). Theoretically, the basis of simulation-based learning is situated mainly in both the constructivist and experiential learning theories. Constructivism is based on the idea that learners construct knowledge through experiences and reflection; therefore, simulations can enhance understanding by allowing learners to engage with content actively. Similarly, experiential learning theory is underlined by the notion of direct experiences in learning. It also points out that when learners can relate concepts to real-life situations, retention improves. Both frameworks confirm our assumption that simulations could enhance the retention of complicated processes by allowing learners to practice, reflect, and modify their knowledge in an ever-changing environment (Burwick, 2022). The integration of simulations into educational and training contexts brings with it a host of benefits. Among the biggest advantages is that learners are much more engaged in motivation and involved in interactive, immersive experiences. Simulations allow learners to apply concepts in practice and bridge the gap between theory and practice. Such hands-on activity reinforces learning and improves retention, as the learner can visualise how his knowledge may be applied to situations. In addition, varied learning styles can be addressed through a simulation: different ways of viewing complex processes can be explored (Battista, 2017). Despite the advantages, a number of challenges are involved in making simulations commonly used in both education and training. In this regard, technical barriers include those dealing with complex hardware and specific software that might limit access in some institutions. There are also some financial hurdles due to the costs developed in creating and maintaining high-quality simulations. Further, design-related problems involve pedagogically sound frameworks with an easy-to-use interface, adding more complexity in building practical simulations. Unless these challenges are addressed, then the full realisation of simulation-based learning will not be achieved (Alinier & Oriot, 2022).

In recent years, there has been a noticeable trend of integrating advanced technologies like VR, AR, and AI-enabled simulations into corporate training and education. These technologies afford real-life experience with the capacity to replicate real-life situations and conditions as much as possible. For example, VR allows learners to move to different environments to practice some elaborate processes and AR to add digital icons to the physical ones. The use of AI in automated simulation can effectively capture individual learner needs and give feedback. These emerging trends suggest that more emphasis is being placed on the importance of innovative instructional design in the retention of complex processes, through use of simulation (Hui et al., 2021).

The use of simulations in education and training has a long history that is now drastically expanding with the use of computers. Simulation practices that have evolved from constructivist and experiential learning theories are remarkably popular for their ability to capture and sustain attention of learners on complex processes. However, due to technology issues, as well as some financial and design issues, these will not be tapped into. The future of simulation-based learning, against the background of current immersive technology trends in instructional design, will be bright and open up new avenues for increasing retention and understanding in a range of educational settings (Battista, 2017).

IV. METHODOLOGY

The present study focused on the impact of simulation-based learning with regard to process understanding and this paper aimed at exploring the way through which the use of this approach can assist in the understanding of processes by learners. Thus, data was gathered using feedback from learners in a simulation-based training course as the source of data. Both quantitative and qualitative data were collected and merged for analysis because the study sought to investigate the experiences and views of the learners. These questions comprised both open-ended questions and close-ended questions used to establish the extent to which process understanding had been improved by the simulation.

A. Data Collection Tools

1. Close-ended Questions

A set of structured, closed questions was developed to assess quantitatively the effectiveness of the simulation in enhancing process understanding. These questions were intended to elicit learners' perceptions on a number of aspects of the simulation, such as:

- **Perceived Learning:** How confident do you feel in your understanding of the process after completing the simulation?
- **Clarity of Process:** How clearly did the simulation explain the steps involved in the process?
- **Engagement:** Did the simulation maintain your interest and encourage you to actively engage in the learning process?
- **Applicability:** Do you feel that the skills and knowledge gained from the simulation can be applied to real-world scenarios?
- **Satisfaction:** Overall, how satisfied are you with the simulation as a learning tool?

These questions used a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), providing a measurable way to assess learners' responses.

2. Open-Ended Questions

Apart from the closed-ended questions, a number of open-ended questions were also present to provide more qualitative responses to the experience of the learners. The questions allowed the participants to explain in detail and offer an in-depth understanding of how the simulation impacted process comprehension. Examples of open-ended questions included:

- What aspects of the simulation helped you understand the process most effectively?
- Were there any challenges or difficulties you encountered during the simulation? If so, how did these impact your learning?
- How do you think this simulation-based learning could be improved to better support process comprehension?
- Can you provide any examples of how the simulation helped you understand the relationships between different steps in the process?

This range of questions enabled the willful response of the learners that offered rich, reflective accounts of the experiences.

B. Data Analysis

1. Quantitative Data Analysis

Responses from the closed-ended questions were summarised using descriptive statistics in the form of mean scores, standard deviations, and frequency distributions in order to describe general trends in learners' perceptions of the simulation for effectiveness. It would decide on those aspects where the simulation was most beneficial and on those where perhaps there was even more potential for enhancement.

2. Qualitative Data Analysis

The process carried out involved going through the answers of the students, grouping similar ideas together, and identifying main themes that could have made a strong impression on the students that were asked the questions. Themes might include aspects such as the realism of the simulation, the clarity of instructions, or specific challenges learners face in understanding the process.

Qualitative data were coded by two independent researchers to provide accuracy and uniformity in analysis. Each of the researchers went through the responses and coded them for key themes and patterns. In cases where the two researchers differed in interpretation, discussion was carried out to come to a consensus on how the data should be categorised. This approach also helped ensure that not only did the individual biases become minimised, but also the reliability and validity of the thematic analysis were enhanced by ensuring consistency in findings that were representative of the participants' experiences.

V. RESULTS/FINDINGS

150 participants participated in this study. Based on the data collected from surveys and interviews, participants reported a significant boost in confidence when performing tasks independently after engaging in a simulation. These step-by-step simulations, taken through the actual process, including the navigation of associated screen layouts, provided realistic hands-on learning that simulated very accurately the real-world scenarios they now face and will be using, day in and day out, in their job.

Overall, an average of about 126 respondents strongly believed that the simulation helped them comprehend a complicated process. By and large, they strongly believed that the simulation was an effective way to explain the process, engaged them as a learner, and met their expectations for a useful learning tool. There were 19 participants in smaller numbers who chose "Agree" for the survey questions to express a positive belief but not as strongly enthusiastic. Meanwhile, on average, 5 participants-maintained neutrality, which said that a great majority of users found the virtual lab to be an influential and interactive learning aid.

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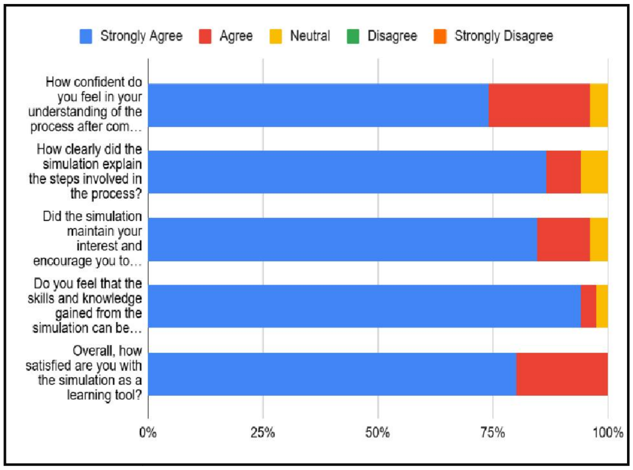

Figure 1: The illustration shows the results of the close-ended survey.

A. Close Ended Survey

Some of the feedback given by participants included that, indeed, step-by-step guidance, appealing interactive visuals, and realistic screen layouts were the most attractive features, which assisted them in deepening their process knowledge. Few experienced some minor technical glitches or found specific instructions wanting more detail, but these did not distract them from learning. This included suggestions such as the need for more detailed instructions for complex steps, incorporation of diverse scenarios, and a summary review to help reinforce key knowledge points. Most participants also commented that this simulation was very effective in showing the interrelation among process steps, identifying which actions might be dependent on others, and changing outcomes based on their own actions. The feedback verified the correctness of the simulation for learning but provided insight into its refinement.

VI. LIMITATIONS

One limitation of this research study is the reliance on self-reported data from surveys and interviews, which may be subject to biases such as social desirability or inaccurate self-assessment of confidence levels. Also, the participant pool, though relatively large with approximately 150 participants, needs to be more representative of the general population to ensure broader generalizability. The setting of the study revolved around one simulation and one process; therefore, the outcomes may not be generalised to other forms of simulations or more complex real-life situations that were beyond the scope of this research study. Some subjects also mentioned that technical problems-such as glitches or unresponsive controls could have affected their experience and learning outcomes overall, introducing variability to the data. In addition, this research should have included long-term follow-up regarding the retention of knowledge and confidence gained through the simulation, thereby leaving uncertainty about the long-lasting impact of training. Lastly, the participants may have had different experiences with similar simulations in the past, which would reflect in their perceptions and also in the effectiveness of this simulation as a learning tool.

VII. IMPLICATIONS/CONCLUSION

This further supports the potential of simulation-based learning to be a very powerful tool in process understanding and in building learner confidence.

Overwhelmingly positive participant feedback supports the efficacy of interactive, step-by-step simulations in replicating real-world scenarios with realistic screen layouts to provide an engaging and practical learning experience. This study really nails the impression of how training tools should be developed to meet users' needs and how simulation can provide an effective link between theory and practice in complex processes. The results also revealed that simulations facilitate active participation and enable the learners to understand how different elements of the processes interact with each other. Therefore, they are effective both for corporate training and educational purposes. However, there were several issues identified such as technical problems, ambiguous directions on a few parts of the module, and the lack of multiple scenarios. All these provide critical pointers toward improvement. Organisations can, therefore, ensure that such lacunae are addressed to refine the effectiveness of simulations as learning tools. Further, this study exposes the need for mechanisms of feedback so that at all times, simulations remain responsive to user needs and technological advancement.

Future studies might examine long-term retention in knowledge and skills acquired through simulation-based learning to better judge the appropriateness of applying such learning in the real world. Generalizability would benefit from extending studies to cover broader participant groups representing different amounts of prior experience. The integration of advanced technologies, such as virtual or augmented reality, might provide insight into how immersive environments impact learning outcomes. A scalability and cost-effectiveness orientation in research could provide insight into deploying simulation tools across larger organisations or diverse contexts. Adaptive simulations offering adjusted content and feedback to meet personal learners' needs may reveal very important advantages in creating personalised learning experiences. Adaptive simulations may provide an enhanced degree of engagement and effectiveness by dynamically adjusting the difficulty, pace, and focus of the simulation based on the learner's progress and performance. These personalised experiences could better ensure the diverse learning styles and skill levels of trainees by having their learning relevant to, and more meaningful for, the person. Further investigation into this domain could result in the improvement of simulations, creating an enhanced methodology through which they can support learners in mastering intricate processes and achieving improved results. This research represents a promising avenue for extending the effectiveness and applicability of simulation-based learning in a wide range of educational and corporate training settings.

REFERENCES

[1]. Teasdale, T. A., Mapes, S. A., Henley, O., Lindsey, J., & Dillard, D. (2016). Instructional Simulation Integrates Research, Education, and Practice. *Gerontology & Geriatrics Education*. https://doi.org/10.1080/02701960.2015.1059831

[2]. Tremblay, M.-L., Leppink, J., Leclerc, G. M., Rethans, J.-J., & Dolmans, D. H. J. M. (2019). Simulation-based education for novices: complex learning tasks promote reflective practice. *Medical Education*. https://doi.org/10.1111/MEDU.13748

[3]. Campos, N., Nogal, M., Caliz, C., & Juan, A. A. (2020). Simulation-based education involving online and on-campus models in different European universities. *International Journal of Educational Technology in Higher Education*. https://doi.org/10.1186/S41239-020-0181-Y

[4]. Melo, B. C. P. de, Falbo, A. R., Bezerra, P. G. de M., & Katz, L. (2018). Perspectivas sobre o uso das diretrizes de desenho instrucional para a simulação na saúde: revisão da literatura. *Social Science & Medicine*. https://doi.org/10.15448/1980-6108.2018.1.28852

[5]. Miller, E. T. (2016). Simulation Is Transforming Education and Practice. *Rehabilitation Nursing*. https://doi.org/10.1002/RNJ.295

[6]. Kadi, Y., & Satori, K. (2019, December 1). Educational Approaches Of Simulation Learning In A Virtual 3d Environment Close To Reality. *International Conference on Intelligent Systems*. https://doi.org/10.1109/ISACS48493.2019.9068861

[7]. Burwick, F. (2022). *Simulations as Collaborative Learning Systems to Enhance Student Performance in Higher Education*. https://doi.org/10.4018/978-1-6684-2468-1.ch020

[8]. Battista, A. (2017). An activity theory perspective of how scenario-based simulations support learning: a descriptive analysis. *Advances in Simulation*. https://doi.org/10.1186/S41077-017-0055-0

[9]. Alinier, G., & Oriot, D. (2022). Simulation-based education: deceiving learners with good intent. *Advances in Simulation*. https://doi.org/10.1186/s41077-022-00206-3

[10]. Hui, A. N. N., Eason, M. S., Cheung, R. C. C., Lai, L. C., Lau, D., & Lam, T. H. S. (2021). *The Relationships Among Simulation-Based Learning, Creativity, and the Learning Approach in Higher Education*. https://doi.org/10.1007/978-3-030-72216-6_6