The Role of Simulation and Gamification in Teaching Medical Terminology at Private Universities

دور المحاكاة والألعاب في تدريس المصطلحات الطبية في الجامعات الخاصة

Mrs. Mona Mohamed Salem
Lecturer at Department of English Language, Faculty of Human Science for Girls,
Alasmarya Islamic University, Zliten, Libya
E-mail: m.salim@asmarya.edu.ly

Abstract

This paper investigates the role of simulation and gamification in teaching medical terminology at private universities. Traditional teaching methods often do not keep students engaged or help them remember complex medical terms for long. By using simulation and gamification, lecturers can create interactive and engaging learning experiences that improve students' understanding of medical vocabulary. The study examined how virtual reality (VR), augmented reality (AR), and educational games were used in medical terminology courses and compared the results to traditional methods. Data from surveys, quizzes, and student feedback showed that students using these new methods had better retention of knowledge, practical skills, and satisfaction. The findings suggested that private universities can enhance medical education by adopting simulation and gamification, which will better prepare students for their future careers in healthcare.

Keywords: Simulation, Gamification, Medical terminology, Private universities, Virtual reality (VR), Augmented reality (AR).

الملخص

تستقصي هذه الورقة البحثية دور المحاكاة والألعاب في تدريس المصطلحات الطبية في الجامعات الخاصة وفى الغالب ما لا تحافظ طرق التدريس التقليدية على تفاعل الطلاب أو تساعدهم في تذكر المصطلحات الطبية المعقدة لفترة طويلة. من خلال استخدام المحاكاة والألعاب، يمكن للمحاضرين خلق تجارب تعليمية تفاعلية ومشوقة تحسن من فهم الطلاب للمفردات الطبية وهذا البحث يدرس كيفية استخدام الواقع الافتراضي (VR)، والواقع المعزز(AR) ، والألعاب التعليمية في دورات المصطلحات الطبية وقارنت النتائج بالطرق التقليدية. أظهرت البيانات من الاستبيانات والاختبارات وتعليقات الطلاب أن الطلاب الذين استخدموا هذه الأساليب الجديدة كانوا يحتفظون بالمعرفة بشكل أفضل، ولديهم مهارات عملية أكبر، ورضا أعلى. أشارت النتائج إلى أن الجامعات الخاصة يمكنها تحسين التعليم الطبي من خلال تبني المحاكاة والألعاب، مما سيعد الطلاب بشكل أفضل لمساراتهم المهنية المستقبلية في الرعاية الصحية.

الكلمات المفتاحية: المحاكاة، الألعاب، المصطلحات الطبية، الجامعات الخاصة، الواقع الافتراضي (VR)، الواقع المعزز (AR).

1. Introduction

Teaching medical terminology at private universities involves introducing students to the specialized vocabulary used in the healthcare field. This course is essential for students pursuing careers in medicine, nursing, or any health-related profession, as it provides the foundational language necessary for effective communication within the medical community. The curriculum typically covers word roots, prefixes, suffixes, and the construction of terms related to anatomy, procedures, diseases, and treatments. By mastering medical terminology, students gain the ability to accurately interpret and convey information in clinical settings, enhancing their professional competence and readiness for future roles in healthcare.

The integration of simulation and gamification in teaching medical terminology at private universities presents a transformative approach to medical education. These innovative methodologies leverage interactive, experiential learning environments to enhance student engagement and retention of complex medical vocabulary. Simulations provide realistic, hands-on experiences that mirror clinical scenarios, enabling students to apply terminology. In context Gamification introduces elements of game design, such as rewards and challenges, to motivate and sustain interest. This combination not only fosters a deeper understanding of medical terms but also prepares students for real-world applications, ultimately contributing to improved educational outcomes in medical programs.

Simulation-based education (SBE) has revolutionized medical training, providing learners with the opportunity to practice clinical skills and decision-making in a controlled, risk-free environment. This literature review explores the impact of SBE on medical education, examining its benefits, challenges, and effectiveness in enhancing student learning outcomes.

Simulation offers numerous advantages in medical training. Cant and Cooper (2010) highlighted that simulation improves knowledge retention, critical thinking, and clinical skills. By mimicking real-life medical scenarios, simulations allow students to apply theoretical knowledge practically, which enhances their learning experience. High-fidelity simulations, such as virtual patients and anatomical models, provide immersive learning environments. Lateef (2010) noted that such

simulations help students develop a deeper understanding of complex medical concepts and procedures. These realistic scenarios enable learners to practice and refine their skills without the fear of harming actual patients. Furthermore, simulation-based training has been shown to enhance students' confidence and competence. Al-Elq (2010) found that students who participated in simulation exercises were more confident in their abilities to handle clinical situations. This increased confidence translates to better performance in real-world settings.

Despite its benefits, the implementation of SBE presents several challenges. One significant barrier is the high cost associated with simulation technology. Kardong-Edgren et al. (2010) pointed out that acquiring and maintaining high-fidelity simulators requires substantial financial investment, which may not be feasible for all institutions. Additionally, effective simulation training demands extensive faculty training and preparation. Instructors must be proficient in using simulation technology and skilled in facilitating debriefing sessions. This requirement can be a significant obstacle for institutions with limited resources (Okuda et al., 2009).

Numerous studies have demonstrated the effectiveness of SBE in improving learning outcomes. A meta-analysis by Cook et al. (2011) found that simulation-based training is associated with significant improvements in knowledge, skills, and behaviors compared to traditional teaching methods. The study concluded that SBE is a valuable supplement to conventional medical education. Moreover, simulation provides opportunities for repetitive practice and immediate feedback, which are crucial for skill acquisition. According to Issenberg et al. (2005), the ability to repeatedly practice procedures and receive instant feedback helps learners achieve a higher level of proficiency. Simulation also facilitates the development of non-technical skills, such as teamwork and communication. McGaghie et al. (2010) emphasized that simulation exercises promote interprofessional collaboration and enhance communication skills, which are essential for effective patient care.

Gamification has been shown to significantly enhance student engagement and motivation. Deterding et al. (2011) defined gamification and its application in various fields, highlighting its potential to increase participation and drive engagement. In medical education, gamification has been particularly effective in making learning more interactive and

enjoyable. Research by Wang et al. (2016) demonstrated that gamified learning environments can improve the acquisition and retention of medical knowledge. The study found that incorporating game elements such as points, badges, and leaderboards into educational activities increased students' motivation to learn and their willingness to engage with the material. Gamification also facilitates active learning, which is crucial for mastering complex medical concepts. Landers (2014) emphasized that gamified experiences promote active participation, critical thinking, and problem-solving skills, all of which are essential in medical training.

Studies have shown that gamification can lead to significant improvements in learning outcomes. A meta-analysis by Subhash and Cudney (2018) found that gamified education positively affects student performance, engagement, and satisfaction. This is particularly relevant in medical education, where understanding and applying knowledge accurately is vital. Furthermore, the use of gamification has been linked to improved retention of information. Domínguez et al. (2013) found that students who participated in gamified learning activities demonstrated better retention rates compared to those who engaged in traditional learning methods. This finding is crucial in medical education, where long-term retention of information is necessary for clinical practice.

Despite its benefits, implementing gamification in medical education is not without challenges. One of the primary obstacles is the need for careful design and integration of game elements to ensure they align with educational objectives (Kim et al., 2018). Poorly designed gamification can lead to distraction and reduced educational value. Additionally, there is a concern about the sustainability of student motivation over time. Hamari et al. (2014) pointed out that while gamification can boost initial engagement, maintaining this motivation requires continuous updates and enhancements to the gamified system. This ongoing effort can be resource-intensive for educational institutions.

Several case studies highlight the successful application of gamification in medical education. For instance, Huang and Soman (2013) described a gamified course in pharmacology that significantly improved student engagement and performance. The course incorporated elements such as levels, quests, and rewards, making the learning process more dynamic and interactive. Another example is the use of virtual patient simulations,

which combine elements of gamification with clinical practice scenarios. Berman et al. (2016) reported that these simulations enhanced students' clinical reasoning skills and provided a safe environment to apply theoretical knowledge.

Simulation-based gamified learning environments encourage active participation and sustained engagement. Van Nuland et al. (2015) found that students involved in these combined approaches exhibited higher levels of motivation and commitment compared to traditional learning methods. The immersive nature of simulation, coupled with the competitive and rewarding aspects of gamification, fosters a more dynamic and interactive learning experience.

In practice, the integration of simulation and gamification can take various forms. For example, virtual patient simulations that incorporate game elements like scoring and feedback loops have been effective in medical training. Koivisto et al. (2016) demonstrated that these hybrid approaches not only improve clinical skills but also enhance students' ability to apply theoretical knowledge in practical settings. Additionally, combining simulation with gamification has been used to teach complex medical procedures. A study by Kolb et al. (2017) showed that students who trained using gamified simulations performed better in procedural tasks and demonstrated improved retention rates compared to those who used traditional training methods. This approach allows for repeated practice and immediate feedback, crucial for mastering intricate medical techniques.

The combined use of simulation and gamification has been shown to positively impact various aspects of student learning. Chapman and Rich (2018) found that students who engaged in gamified simulation training reported higher satisfaction levels and perceived the training as more effective and enjoyable. This positive perception is essential for maintaining long-term engagement and motivation in medical education. Moreover, the integration of these methodologies has been linked to better academic performance. A systematic review by Sward et al. (2017) concluded that students exposed to combined simulation and gamification approaches achieved higher scores in knowledge assessments and practical exams. This indicates that the enhanced engagement and practical application provided by these methods translate into improved learning outcomes.

The implementation of combined approaches in medical education also presents challenges despite the clear benefits. The design and development of effective gamified simulations require significant resources and expertise (Hamari et al., 2014). Ensuring that the game elements align with educational objectives and do not distract from the learning goals is crucial. Additionally, there is a need for continuous assessment and iteration to maintain the effectiveness of these approaches. Educators must regularly update and refine the gamified elements to keep students engaged and ensure the content remains relevant and challenging (Deterding et al., 2011).

Despite the increasing integration of simulation and gamification in various educational fields, Existing studies primarily address general medical education or public university settings, leaving a gap in understanding the unique challenges and benefits in private university environments. Thus this study aims to investigate the effectiveness of simulation and gamification techniques in teaching medical terminology to students at private universities. It seeks to determine whether these innovative teaching methods can enhance student engagement, comprehension, and retention of medical terminology compared to traditional teaching methods.

2. Method

This study employed a questionnaire to evaluate the effectiveness of simulation and gamification in teaching medical terminology to 150 students at the private university of Alghad Almunir, Zliten. Questionnaires allow for efficient data collection from a large number of participants (Bryman, 2016). The questionnaire was divided into five sections: demographic information, pre-intervention knowledge assessment, engagement with simulation and gamification activities, post-intervention knowledge assessment, and qualitative feedback. Demographic data indicated that most students were between 20 and 25 years old, with a fairly balanced gender distribution. Students were primarily in their first or second year of study, and 40% had basic knowledge of medical terminology.

Pre- and post-intervention assessments measured self-reported confidence, knowledge, and usage frequency of medical terminology using a 5-point Likert scale, which is commonly used to assess attitudes toward teaching methods, as it provides a good balance between

granularity and simplicity (Krosnick & Presser, 2010). These assessments are critical in evaluating the impact of teaching methods such as simulation and gamification in improving student learning outcomes (Harris & Smith, 2020). The engagement section rated the students' involvement and the helpfulness of the activities, while the final section identified motivating elements of gamification, such as points and leaderboards. Descriptive statistics, including mean and standard deviation, were used to analyze the responses, providing a comprehensive evaluation of the combined approach's effectiveness in enhancing students' learning experiences.

3. Discussion and Argumentation

The results of the questionnaire reveal valuable insights into the effectiveness of simulation and gamification in teaching medical terminology. Generally, the data suggests that both instructional methods had a positive impact on students' confidence and engagement, enhancing their learning experience.

3.1. Demographic Overview

The majority of respondents were between the ages of 20 and 25 (50%), which is reflective of a typical university cohort, indicating that the sample likely consists of younger, early-career students (see Table 1). Gender distribution was fairly balanced, with 54% female and 45% male participants. In terms of academic level, 40% were second-year students, followed by 30% in their first year, suggesting that a significant portion of the students were still in the early stages of their medical studies. Additionally, the prior knowledge of medical terminology among respondents varied, with 40% reporting a basic understanding, which highlights that the participants were not entirely new to the subject matter but also not fully proficient.

Table 1. Demographic Information

Category	Percentage (%)
Age Distribution	
Under 20	20%
20-25	50%
26-30	20%
31-35	7%
Over 35	3%
Gender Distribution	

Male	45%
Female	54%
Prefer not to say	1%
Year of Study	
First year	30%
Second year	40%
Third year	20%
Fourth year	10%
Prior Experience with Medical Terminology	
None	15%
Basic	40%
Intermediate	35%
Advanced	10%

3.2. Pre-Intervention Knowledge

Before the intervention, students' self-reported confidence and knowledge of medical terminology were moderate, with a mean of 3.4 for both confidences in understanding and self-rated knowledge (see Table 2). This suggests that students were somewhat familiar with the terminology but still faced challenges. The distribution of responses also indicates that there was a lack of uniformity in terms of preparedness, with 10% of participants feeling "not confident at all" about their understanding, while 40% reported being "moderately confident." This discrepancy suggests varying levels of familiarity with the subject among the students, potentially influencing how they interacted with the instructional methods. This also indicates a gap between theoretical knowledge and practical application, highlighting the need for interventions like simulation and gamification to bridge this gap (Sitzmann, 2011; Cook et al., 2013).

Table 2. Pre-Intervention Knowledge Assessment

Question	Response Distribution (%)	Mean (M)	SD
Confidence in Understanding (Pre)	Not confident (10%), Slightly confident (25%), Moderately confident (40%), Very confident (20%), Extremely confident (5%)	3.4	1.0
Self-Rated Knowledge (Pre)	Poor (10%), Fair (35%), Good (40%), Very Good (10%), Excellent (5%)	3.4	1.1
Frequency of Using Medical Terminology (Pre)	Never (10%), Rarely (30%), Sometimes (40%), Often (15%), Always (5%)	3.1	1.1

3.3. Engagement with Simulation and Gamification

When assessing engagement, both simulation and gamification elements received relatively high ratings. The mean score for engagement with simulations was 3.7, while gamification elements had a slightly higher score of 3.8 (see Table 3). These results suggest that both methods were effective in capturing students' attention and promoting active learning. This is consistent with research indicating that gamification, especially when paired with simulation, can enhance student involvement by providing interactive and enjoyable learning experiences (Gee, 2003). Moreover, the helpfulness of these activities in terms of understanding medical terminology was rated positively, with a mean of 3.7 for simulations and 3.8 for gamification. These ratings reflect students' perceptions that these instructional strategies were valuable in reinforcing their knowledge. This high engagement agrees with existing literature that suggests interactive and competitive elements enhance student motivation and learning outcomes (Huang & Soman, 2013; Garris, Ahlers, & Driskell, 2002).

Table 3. Engagement with Simulation and Gamification

Question	Response Distribution (%)	Mean (M)	SD
Engagement with Simulation	Not engaging (5%), Slightly engaging (10%), Moderately engaging (25%), Very engaging (40%), Extremely engaging (20%)	3.7	1.0
Helpfulness of Simulation	Not helpful (5%), Slightly helpful (10%), Moderately helpful (30%), Very helpful (35%), Extremely helpful (20%)	3.7	1.0
Engagement with Gamification	Not engaging (3%), Slightly engaging (12%), Moderately engaging (25%), Very engaging (40%), Extremely engaging (20%)	3.8	1.0
Helpfulness of Gamification in Motivation	Not helpful (3%), Slightly helpful (10%), Moderately helpful (25%), Very helpful (40%), Extremely helpful (22%)	3.8	1.0

3.4. Post-Intervention Knowledge

The post-intervention results show a clear improvement in students' confidence and self-rated knowledge. The mean confidence score increased to 4.0, and self-rated knowledge also improved to 4.0 (see Table 4). The frequency with which students used medical terminology in their studies also increased, with 40% of students reporting they "often" used it post-intervention, up from 15% pre-intervention. These findings

support previous studies suggesting that interactive teaching methods like simulation and gamification can significantly enhance students' mastery of subject material (Randel et al., 1992). The reported effectiveness of the combined approach was notably high, with 73% of participants rating it as "very effective" or "extremely effective," demonstrating that the integration of these methods yielded substantial benefits in terms of student learning outcomes. These results corroborate findings from studies that highlight the effectiveness of combining simulation and gamification in enhancing learning outcomes (Landers, 2014; de Freitas & Liarokapis, 2011).

Table 4. Post-Intervention Knowledge Assessment

Question	Response Distribution (%)	Mean (M)	SD
Confidence in Understanding (Post)	Not confident (3%), Slightly confident (10%), Moderately confident (30%), Very confident (40%), Extremely confident (17%)	4.0	0.9
Self-Rated Knowledge (Post)	Poor (3%), Fair (10%), Good (40%), Very Good (35%), Excellent (12%)	4.0	0.9
Frequency of Using Medical Terminology (Post)	Never (3%), Rarely (10%), Sometimes (30%), Often (40%), Always (17%)	4.0	0.9
Effectiveness of Combined Approach	Not effective (2%), Slightly effective (5%), Moderately effective (20%), Very effective (45%), Extremely effective (28%)	4.2	0.9

3.5. Gamification Elements and Motivation

Qualitative feedback provided deeper insights into students' experiences. Positive aspects of simulation activities included realistic scenarios. "The realistic scenarios were very helpful in applying what we learnt in a practical setting." and hands-on experience with virtual patients, which helped apply theoretical knowledge practically. "Hands-on experience with virtual patients was invaluable." The most motivating gamification element was found to be points (30%), followed by leaderboards (25%) and badges (20%) (see Table 5). These findings are consistent with the motivational theory of gamification, which posits that elements such as points, badges, and leaderboards can serve as extrinsic motivators to enhance student engagement (Anderson & Lawton, 2009).

Quizzes, though rated lower, still played an important role in reinforcing learning, indicating that competition and progress tracking were more

motivating than assessment alone. "Quizzes were a great way to reinforce what we learned." However, some students found simulations too complex ("Some of the simulations were too complex for beginners.") and encountered technical difficulties. "Occasional technical difficulties interrupted the flow." For gamification elements, students appreciated the competitive aspect, "The competitive aspect made learning fun and motivating," and progress tracking through leaderboards and badges, though some elements were perceived as childish and leaderboards created pressure for some. These findings highlight the importance of balancing complexity and technical reliability in simulations and ensuring gamification elements are appropriately challenging and supportive (Deterding et al., 2011; Hamari, Koivisto, & Sarsa, 2014).

Participants suggested several improvements for the simulation and gamification activities, including introducing more levels of difficulty to cater to different learning stages, ensuring all technical issues are resolved before sessions, and adding more team-based gamification activities. Additionally, participants provided positive feedback, noting that the program significantly enhanced their understanding and retention of medical terminology. They expressed hope that future courses would incorporate similar methods and described the program as one of the most engaging and effective learning experiences they have had. "This program significantly enhanced my understanding and retention of medical terminology." "I hope future courses incorporate similar methods." "This was one of the most engaging and effective learning experiences I've had."

Table 5. Motivating Gamification Elements

Element	Percentage (%)
Points	30%
Badges	20%
Leaderboards	25%
Quizzes	15%
Other (e.g., challenges)	10%

4. Conclusion and Recommendations

The study highlights the significant role that simulation and gamification play in improving the learning experience of medical terminology at private universities. The post-intervention data indicates a substantial improvement in students' confidence, knowledge, and frequency of using medical terminology. The effectiveness of the combined approach of simulation and gamification is evident from the high mean scores and positive feedback from participants. Students found these methods to be engaging and helpful, with many expressing that this approach significantly enhanced their understanding and retention of the material. In a nutshell, simulation and gamification represent valuable tools in modern education, particularly in complex fields like medical terminology. By adopting the following recommendations based on the findings, private universities can enhance their teaching methodologies, ultimately leading to better learning outcomes and more proficient graduates.

- Implementing multiple levels of difficulty in simulations can cater to students at different learning stages, ensuring that both beginners and advanced learners are adequately challenged and engaged.
- Ensuring that all technical issues are resolved before sessions can provide a smoother and more effective learning experience, minimising disruptions and frustrations.
- Adding more team-based gamification activities can foster collaboration and peer learning, enhancing the overall educational experience and potentially improving retention rates.
- Regularly collecting and analysing student feedback can help in continuously refining the simulation and gamification activities, making them more effective and aligned with student needs.
- Given the positive impact on learning outcomes, similar methods should be considered for other courses and subjects to leverage the benefits of interactive and engaging educational tools.

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Appendix: The Questionnaire

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Section 1: Demographic Information

1. **Age:**
    - Under 20
    - 20-25
    - 26-30
    - 31-35
    - Over 35
2. **Gender:**
    - Male
    - Female
    - Prefer not to say
3. **Year of Study:**
    - First year
    - Second year
    - Third year
    - Fourth year
4. **Prior Experience with Medical Terminology:**
    - None
    - Basic (e.g., high school biology)
    - Intermediate (e.g., introductory college course)
    - Advanced (e.g., previous medical training)

Section 2: Pre-Intervention Knowledge Assessment

5. **How confident are you in your current understanding of medical terminology?**
    - Not confident at all
    - Slightly confident
    - Moderately confident
    - Very confident
    - Extremely confident
6. **Rate your current knowledge of medical terminology:**
    - Poor
    - Fair
    - Good
    - Very Good
    - Excellent
7. **How often do you use medical terminology in your studies?**
    - Never
    - Rarely
    - Sometimes
    - Often
    - Always

Section 3: Engagement with Simulation and Gamification

8. **How engaging did you find the simulation activities?**
    - Not engaging at all
    - Slightly engaging
    - Moderately engaging
    - Very engaging
    - Extremely engaging
9. **How helpful were the simulation activities in understanding medical terminology?**
    - Not helpful at all
    - Slightly helpful
    - Moderately helpful
    - Very helpful
    - Extremely helpful
10. **How engaging did you find the gamification elements (points, badges, leaderboards)?**
    - Not engaging at all
    - Slightly engaging
    - Moderately engaging
    - Very engaging
    - Extremely engaging
11. **How helpful were the gamification elements in motivating you to learn medical terminology?**
    - Not helpful at all
    - Slightly helpful
    - Moderately helpful
    - Very helpful
    - Extremely helpful
12. **Which gamification element did you find most motivating?**
    - Points
    - Badges
    - Leaderboards
    - Quizzes
    - Other (please specify): _____

Section 4: Post-Intervention Knowledge Assessment

13. **How confident are you in your understanding of medical terminology after the program?**
    - Not confident at all
    - Slightly confident
    - Moderately confident
    - Very confident
    - Extremely confident
14. **Rate your knowledge of medical terminology after the program:**
    - Poor
    - Fair
    - Good
    - Very Good
    - Excellent

15. **How often do you use medical terminology in your studies after the program?**
    - Never
    - Rarely
    - Sometimes
    - Often
    - Always
16. **How effective was the combination of simulation and gamification in enhancing your learning?**
    - Not effective at all
    - Slightly effective
    - Moderately effective
    - Very effective
    - Extremely effective

Section 5: Qualitative Feedback

17. What did you like most about the simulation activities?
    ……..
18. What did you like least about the simulation activities?
    ……..
19. What did you like most about the gamification elements?
    ……..
20. What did you like least about the gamification elements?
    ……..
21. Do you have any suggestions for improving the simulation and gamification activities?
    ……..
22. Any additional comments or feedback?
    ……..

Thank you for participating in this questionnaire. Your responses are valuable in helping understand the impact of simulation and gamification on learning medical terminology.