

GAMIFICATION AS A TOOL FOR IMPROVING LEARNING OUTCOMES AMONG MEDICAL STUDENTS: A COMPARATIVE ANALYSIS WITH TRADITIONAL TEACHING

Nivetha D¹, Indhumathi M², Israel Raja Johnley I³, Meenakshi B⁴

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Corresponding Author:
Dr. Nivetha D.
Email: nive1319@gmail.com

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¹Assistant Professor, Department of Pharmacology, Government Thoothukudi Medical College, Thoothukudi, Tamilnadu, India.

²Assistant Professor, Department of Pharmacology, Government Thoothukudi Medical College, Thoothukudi, Tamilnadu, India.

³Assistant Professor, Department of Pharmacology, Government Thoothukudi Medical College, Thoothukudi, Tamilnadu, India.

⁴Professor & Head, Department of Pharmacology, Government Thoothukudi Medical College, Thoothukudi, Tamilnadu, India.

ABSTRACT

Background: Traditional teaching is a teacher centred approach with limited interactivity. Gamification aims to promote learners' engagement and improve learning outcomes. Hence, the aim of this study is to assess the effectiveness of gamification as a tool in medical education. **Materials and Methods:** This prospective, interventional study involved 150 Phase II MBBS students. Ethical approval was obtained. Based on systematic sampling method, students were divided into two groups (Team A & Team B). Two topics were randomly selected for the study. During session-1, Team A students were delivered with gamification-based lecture (wordwall.net tool with monthly subscription) and Team B was delivered with traditional lecture. During session-2, teams were crossed-over and same procedure was repeated for a different topic. Validated feedbacks were collected through questionnaires and knowledge gained was assessed through multiple-choice questions (MCQs). Four weeks later, knowledge retention was assessed for the students from both the groups. **Results:** The mean score for knowledge gain and knowledge retention in the gamified group was 13.8 and 5.79 compared to 11.1 and 4.08 for non-gamified group respectively, with a p-value indicating statistical significance ($p < 0.001$). Feedback on Likert scale (1-5) showed mean scores with significant difference for questions covering the aspects of learners' engagement (4.49 & 3.5), interaction with peers (4.52 & 3.56) & overall satisfaction (4.72 & 4.02). Students also reported of having greater engagement, enjoyment and better ability to retain the concepts in gamified sessions. **Conclusion:** Gamification in medical education notably enhance students' engagement and learning outcomes compared to traditional methods. The affirmative student feedbacks and significant results in test scores suggest that gamification can be adopted as a highly effective educational strategy.

INTRODUCTION

Traditional learning, also known as conventional or classroom-based learning, has been the predominant approach to education for centuries.^[1] It primarily involves face-to-face interactions, the use of textbooks and lectures delivered by instructors within a structured curriculum in classrooms. It emphasises the transfer of knowledge from the teacher to the students through direct instructions. Although it has been the foundation of formal education for centuries, the traditional way is a teacher centred, passive learning method with limited interactivity.

Thus, it does not promote critical thinking, creativity, and does not prepare learners for real-life situations in this digital era. To meet the needs of the internet generation, both preclinical and clinical medical teaching need to evolve beyond traditional approaches to infuse new tools and media into curriculum. One of the current challenges faced by medical educators is the need to develop innovative approaches that make learning more stimulating, motivating, and engaging. Leading experts in medical education have long advocated for the adoption of teaching methods that emphasize student-based active learning strategies, commonly

referred to as learner-centred education. Gamification means applying game attributes to something that is essentially not a game. A common definition is ‘the use of game design elements in non-game contexts.’^[1] It encompasses all four major game-based pedagogical theory elements, affective, behavioural, cognitive, and social/cultural engagement.^[2] Game based learning is a newly evolving platform for medical graduates. These educational games incorporate principles of adult learning, promoting self-directed learning and encouraging active participation in group activities, making the process enjoyable. As a result, students become more actively engaged in their learning process, leading to improved learning outcome through better understanding, retention and the ability to integrate and analyse the subject effectively. Furthermore, a subject as complex as Pharmacology often discourage students from exploring the subject with enthusiasm and making it difficult for them to understand its basic concepts. Students often resort to rote memorization to pass exams, without understanding how to apply knowledge clinically. Here we can simulate clinical scenarios where drug mechanisms are applied, improving application skills. Thus, gamification transforms passive learning into active participation and encourages deeper cognitive processing. It helps students remember better by making them recall information often.

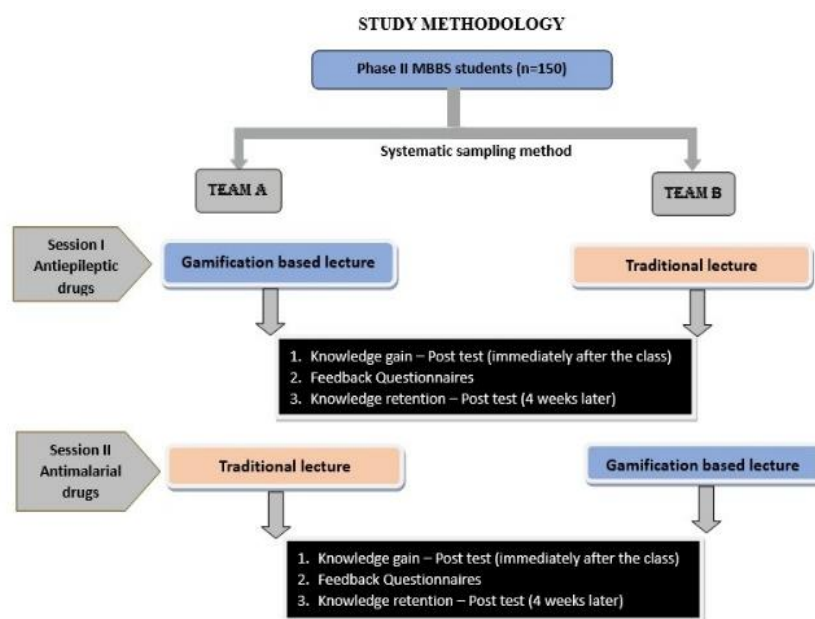
While gamification in medical education is growing, mixed reports on its efficacy have been published^[3] and also Pharmacology-specific evidence remains limited. To address this crucial gap in the current literature, it is essential to review the outcomes and effectiveness of gamification to support its use in medical education. Hence the aim of this study was to assess the effectiveness of gamification as a tool

for improving learning outcomes among medical students.

MATERIALS AND METHODS

A Prospective interventional study among 150 Phase II MBBS students was conducted at Department of Pharmacology for a period of 1 month (January 2025), to assess how gamification influences learning outcomes among medical students. Ethical approval was obtained from the Institutional Ethics Committee with IEC Ref no: (03/2024-01). Based on the systematic sampling method, the students were divided into two groups: Team A and Team B. Two topics were randomly selected for this study (Antiepileptic drugs and Antimalarial drugs). Students were informed about the study procedure in advance. However, they were not made aware of the teaching methodology assigned to their team until the commencement of the session. Relevant study materials were shared one day prior to each session to ensure adequate preparation.

During session 1, Team A attended gamification-based lecture using the Wordwall.net platform with monthly subscription, while Team B attended traditional lecture on Antiepileptic drugs. During session 2, the teaching methods were interchanged. Team A attended a traditional lecture, and Team B participated in a gamification-based session on Antimalarial drugs. At the end of each session, knowledge gain was assessed through multiple-choice questions (MCQs). In addition, validated feedbacks were collected from every student using structured questionnaires to evaluate the effectiveness and engagement of both teaching methods. Four weeks later, knowledge retention was assessed for the students from both the groups.



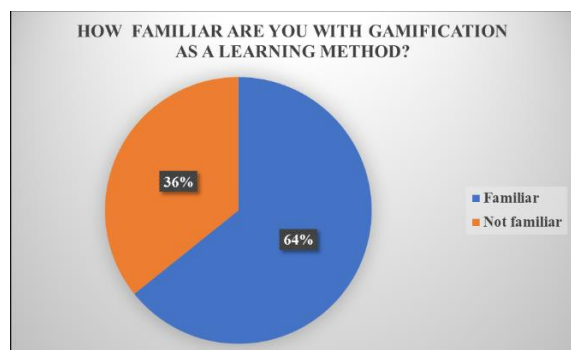
RESULTS

The mean score for knowledge gain and knowledge retention in the gamified group was 13.8 (SD =1.15) and 5.79 (SD =2.16) compared to 11.1(SD =1.34) and 4.08(SD =1.26) for non-gamified group respectively, with a p-value indicating statistical significance ($p < 0.001$) using Wilcoxon signed – rank test) (Table-1). Most of the students (64%) were familiar with gamification as a learning method (Graph-1). The feedback ratings for gamification-based teaching were higher than those for traditional lectures.

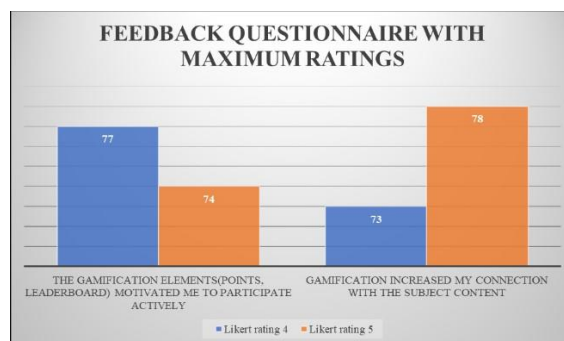
Students reported greater engagement, improved critical thinking, better retention of knowledge, increased interaction with peers, and higher overall satisfaction with gamification (Graph-2). Students predominantly gave maximum ratings (Likert score 4 & 5), indicating that gamification elements strongly motivated them to participate actively and increased their connection with the subject (Graph-3). The figure (Graph-4) illustrates the aspects of gamified sessions, that students found most useful. Majority of the students (89%), recommended gamification in their upcoming lectures (Graph-5).

Table 1: Comparison of mean scores (knowledge gain & knowledge retention) in gamification and traditional Lectures

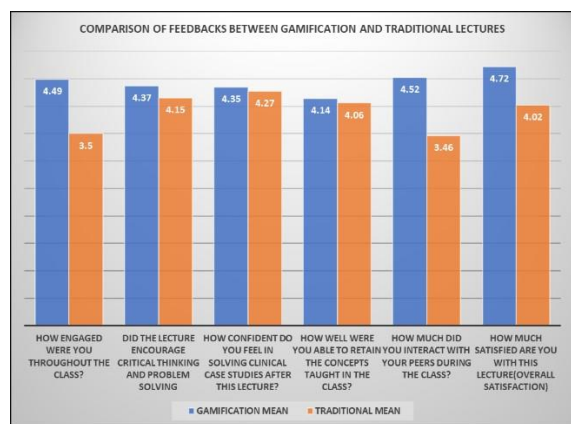
| Observation | GAMIFICATION | | RADITIONAL | |
|---------------------|--------------|------|------------|------|
| | Mean | SD | Mean | SD |
| Knowledge gain | 13.8 | 1.15 | 11.1 | 1.34 |
| Knowledge retention | 5.79 | 2.16 | 4.08 | 1.26 |



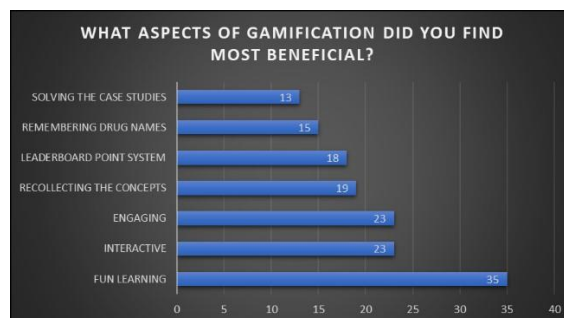
Graph-1: Familiarity of students with gamification as learning method



Graph-3: Feedback questionnaire with maximum rating in gamified session



Graph-2: Comparison of feedbacks between gamification and traditional lectures



Graph-4: Feedback questionnaire – open ended question



Graph-5: Feedback questionnaire – open ended question

DISCUSSION

Traditional lectures have been effective in medical education for many years, but current generation medical students have reduced attention span and increased preference for interactive learning environment. Thus, passive lecture based teaching fails to sustain engagement and optimize their learning. However, game-based learning promotes active participation and motivation among the learners in this digital era.^[1,3]

Learning outcomes: knowledge gain and knowledge retention

This study demonstrated that gamification-based lectures significantly enhanced the knowledge gain among Phase II MBBS students compared to traditional teaching. Knowledge gain is defined as the level of knowledge demonstrated by students immediately after the educational intervention, as measured by post-test scores.^[4] The mean post-test score for the gamified group (13.8 ± 1.15) exceeded the non-gamified group (11.1 ± 1.34), with a statistically significant p value. These findings suggest that gamification can improve learning outcomes in medical education. This is similar to other studies,^[5,6,7,8] showing positive effects of gamified and interactive learning on knowledge acquisition. These studies state that, incorporating gamification into Medical Biochemistry and Pharmacology teaching leads to enhanced students academic performance, as reflected by higher post test mean scores on objective assessments.^[9] In this study, the interactive features of the Wordwall.net platform strengthened learning through immediate feedback and improved students insight into their performance. This study also evaluated knowledge retention four weeks after the intervention. Knowledge retention refers to the ability of learners to preserve and recall previously learned information after a period of time, without re-exposure to the content.^[10] The gamified group scored higher on retention measures than the non-gamified group (5.8 vs. 4.08). The higher knowledge retention scores observed in the gamified group may be attributed to repeated exposure to concepts and active retrieval of information, both of which are known to facilitate long term memory. This suggests that gamification not only enhances immediate performance but also supports sustained learning.

Familiarity of students with gamification

In this study, 64% of students reported familiarity with gamification as a learning method, which reflects the learning preferences of generation Z students. They are often referred as Homo Zapien's /digital natives - a cohort born and raised in a digital era who integrates technology into their everyday life. Research shows that they prefer interactive, visual and multimedia-based learning over passive, traditional lecture-based learning.^[11]

Students feedback and perceptions

The feedback analysis revealed that gamification-based teaching was rated higher than traditional lectures across multiple domains such as learners' engagement, critical thinking and problem solving, knowledge retention, peer interaction, and overall satisfaction. Students reported greater engagement throughout gamified session, suggesting that the interactive nature of gamification sustained learners' attention throughout the session, which leads to better knowledge gain and retention observed in the gamified group. This finding correlates with the study done by Janssen et al.,^[12] who demonstrated that a team-based digital game significantly improved attention and motivation in their study group. Furthermore, higher ratings for encouraging critical thinking and problem-solving abilities, indicates that gamified activities foster higher order critical thinking skills that helps to integrate theoretical knowledge with practical scenarios. The significantly higher feedback scores related to peer interaction in the present study are also supported by prior studies,^[5,12] which emphasized that collaborative gameplay encourages teamwork, discussion and social learning atmosphere. Such interaction is often limited in traditional lectures, which may explain the comparatively lower scores observed in the non-gamified group. The enjoyment, novelty and reduced stress associated with gamified sessions may have contributed to the higher overall satisfaction for this approach. This is consistent with the study by Cantwell et al.,^[13] in which most learners preferred incorporating more gamified activities into medical education. Thus, gamification not only enhances cognitive outcomes but also positively influences affective domains of learning.

Open ended questions

Analysis of the open-ended feedback questions regarding the beneficial aspects of game-based learning revealed that fun learning (n=35) as the most beneficial aspect, followed by interactivity and enhanced engagement (n=23). This suggest that gamification helps to reduce the complexity and monotony of medical subjects. These findings are consistent with earlier studies,^[5,6,13,14] which reported that increased enthusiasm and sustained attention were central to students effective learning. Regarding cognitive outcomes, students reported that better recollection of concepts (n=19) and the leaderboard point system (n=18) were helpful. This finding is supported by Pesare et al.,^[14] and Boeker et al.,^[15] who emphasized that competitive elements such as scoring, ranking and rewards encourage repeated participation and reinforce the concepts better. However, only few students (n=13) perceived that remembering drugs name in Pharmacology was better with this type of learning method. This can be addressed in future by including games that help to reinforce drugs name effectively.

In the present study, 89% of students recommended the use of gamification in future classes, reflecting high acceptance and viewed it as a motivating and

learner-centred approach. This is consistent with the previous studies,^[5,6,13] which reported strong student preference for gamified learning. However, few students reported that the time required to adapt to the new format and minor technical difficulties as short-term barriers for their effective participation. Similar challenges have been reported in studies,^[13,16] during initial exposure to game-based learning.

CONCLUSION

This study suggests that gamification enhances both cognitive and affective learning outcomes and aligns well with the learning preferences of this generation medical students. Incorporating gamified strategies alongside conventional lectures may therefore provide a more engaging, interactive, and effective learning environment in undergraduate medical education. This makes the students to retain the complex Pharmacology concepts better. However, the limitation of this study is, it included only 2 Pharmacology topics and conducted in a single Institution which limits its generalizability.

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