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RESEARCH ARTICLE

Impact of gamification strategies applied to an institutional pharmacy department education

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Abstract

Background: The methods used by health systems and pharmacy departments to educate personnel and uphold competency standards are variable. Gamification uses motivational affordances, commonly in game-like environments, to increase user engagement. There is limited data on the use of gamification in pharmacy workforce education. **Objective:** To evaluate the impact of gamification strategies on education in a pharmacy department via post-module assessment scores and satisfaction survey results. **Methods:** This prospective randomised controlled trial enrolled institutional pharmacy department employees assigned to a control group receiving traditional education or an intervention group receiving gamified education. After completion, employees were given an assessment and a satisfaction survey. The primary endpoint was post-module assessment scores. The secondary endpoint was satisfaction survey scores. **Results:** The study included 55 pharmacists and 17 technicians. The gamification group experienced higher median post-module assessment scores in two modules ($p < 0.0001$). The gamification group also reported higher satisfaction in all three modules, with notable differences in overall median satisfaction scores for two of the five survey questions; these two questions concerned engagement and enjoyment. **Conclusion:** This study demonstrated the positive impact of gamification on pharmacy department personnel's academic performance and engagement. Future studies are needed to investigate gamification elements that primarily affect user knowledge retention.

Introduction

Health systems in the United States routinely strive to uphold standards established by accrediting bodies to standardise the delivery of patient care. The Agency for Healthcare Research and Quality defines a health system as an "*organisation that includes at least one hospital and at least one group of physicians that provides comprehensive care (including primary and specialty care), connected with each other and with the hospital through common ownership or joint management*" (Agency for Healthcare Research and Quality, 2023). One of those standards identified by The Joint Commission is competency, defined as the triad of knowledge, technical skills, and ability (The Joint Commission, 2022). Health systems utilise various methods to ensure personnel remain knowledgeable of tasks and information relating to their job responsibilities. The topics commonly being refreshed and tested include concepts that allow health systems to retain regulatory compliance and uphold patient care standards (The Joint Commission, 2022). The methods of educating and testing personnel to achieve competency can be widely variable across employers.

A traditional method to deliver mandatory training and educational material for employees includes self-paced study modules. In health systems, these modules often range from general healthcare-based topics, such as infection control, to specific areas needed for the department's personnel proficiency. Some training programmes are one-time, while others are annual, with the number of sessions varying based on practice areas and the individual responsibilities of the team member. For example, a pharmacist with dispensing responsibilities may have an additional practicum that

a pharmacist who exclusively rounds in units would require. Research has shown that self-paced learning enhances memory performance, including concept recognition (Tullis & Benjamin, 2011). However, allowing individuals the freedom to allocate their study time likely influences their performance. Devoting more study time to the most intricate material improves performance compared to not self-allocating study time (Tullis & Benjamin, 2011). Contributing factors, such as intrinsic motivation, may influence how much time an individual devotes to self-paced learning modules (Tullis & Benjamin, 2011). Gamification is one method that has gained popularity due to its ability to increase learner motivation and thus combat low engagement, which poses training fatigue challenges from a human resources perspective (Gallup Inc., 2017).

The concept of gamification has been successfully introduced into various higher education fields, including health science education (Van Gaalen *et al.,* 2021). Gamification involves using game design elements, including game mechanics, in educational materials (Nah *et al.,* 2013). It focuses on providing motivational affordances or variations of "*games*" to increase user motivation (Nah *et al.,* 2013; Hamari *et al.,* 2014; Arruzza & Chau, 2021). Points, leaderboards, feedback, and progress trackers are motivational tool examples used in gamification to target learners (Hamari *et al.,* 2014). Common, recognisable examples of gamification strategies in the general population are Kahoot! and Duolingo. Both applications employ game-based learning to enhance user motivation and engagement while promoting consistent learning (Huynh & Iida, 2017). The current literature surrounding the use of gamification supports the positive impacts this method has on various learner types (Hamari *et al.,* 2014). However, the positive effects of gamification on behavioural categories, such as user motivation, have been reported to varying degrees. Studies show that the influence of gamification on intrinsic motivation still largely depends on the individual user (Dahlstrøm, 2003). Gamification has been reported to "*facilitate and undermine intrinsic motivation*" through an individual's perceived need for autonomy and competency (Dahlstrøm, 2003). The vague definition of gamification and the vast utilisation of different variations in the method make it hard to assess the strategy's effectiveness (Arufe Giráldez *et al.,* 2022). Many studies support the need for more conclusive and reproducible literature on the impact of gamification.

The positive impact of gamification on user satisfaction has been consistently demonstrated in the literature (Hamari *et al.,* 2014; Arufe Giráldez *et al.,* 2022). The goal of gamification is to replicate the feelings associated with playing a game to achieve higher levels of learner satisfaction. Many industries, including health science fields, have shown that gamification improves learner satisfaction (Arruzza & Chau, 2021). A randomised controlled study concluded that game-based learning among physicians was effective in delivering continuing medical education to physicians and resulted in higher satisfaction scores, with 94% of physicians in the game-based group strongly agreeing that the event was enjoyable compared to 53% in the case-based group (Telner *et al.,* 2010). Those in the game-based group also exhibited higher levels of attention and a higher likelihood of completing a similar event again. Gamification has been included in pharmacist education curricula. A literature review of gamification in pharmacy education found 66 articles of different gamified activities with various outcomes; however, the criteria for "*gamified*" activities overlapped heavily with general competency-based learning activities and interprofessional learning activities, making it difficult to compare findings (Hope et al., 2023). According to current literature findings, gamification strategies may increase employee engagement and satisfaction when applied to pharmacy-related educational modules.

Gamification has also been shown to have a positive impact on patient care. One study demonstrated increased knowledge of hypertension management among clinicians, resulting in decreased time to target blood pressure for patients (Kerfoot *et al.,* 2014). The median time to target blood pressure was 137 days for the gamification group versus 145 days for the traditional group (Kerfoot *et al.,* 2014). While this particular study cannot be applied to the entirety of healthcare professionals, its results are encouraging and show that this form of education is appealing to those in the healthcare workforce. Another study found higher post-module assessment scores among healthcare professionals who used gamified modules (Gentry *et al.,* 2019). Both studies support the idea that gamification of learning among health professionals leads to higher scores and improved clinical outcomes (Kerfoot *et al.,* 2014; Gentry *et al.,* 2019).

The impact of gamification on the pharmacy workforce remains unknown. Various reports on the novel use of gamification to deliver education have highlighted the potential benefits, such as improved employee satisfaction, engagement, and professional development, that this method may have for an entire workforce. However, little is known about the gamification approach used to deliver training and educational content to pharmacy personnel in a health system. This study aimed to assess the impact of gamification applied to annual learning modules on engagement, completion time, and competency of hospital pharmacy professionals. The hypothesis is that

there will be a difference in academic performance, as defined by post-module assessment scores, between those who complete the gamified modules versus the traditional modules.

Methods

Study design

At Texas Children's Hospital (TCH), pharmacy department personnel have demonstrated low engagement with the traditional educational modules. Some of the modules have low average pass rates and a high number of attempts, which may contribute to learner discouragement and additional time for completion. Moreover, the modules currently used at TCH have minimal interactive features, which may result in lower engagement levels among team members. This setting identified a need within the department for a new education delivery method.

This study aimed to determine whether gamification of educational modules improves assessment scores of pharmacy professionals on required education using a randomised controlled study design. The primary outcome is the difference in mean total score between the control and gamification groups. Game elements were introduced during and after content delivery, as appropriate, to help deliver and interact with course materials. Secondary outcomes included satisfaction survey results, differences in mean score per module, and first-time pass rates overall and per module. The satisfaction survey was administered via a REDCap and posed these five questions: a) Overall, I was satisfied with the quality of the module; b) The module was engaging; c) The module was informative; d) The module was easy to follow; e) The module was enjoyable. Responders could choose one of five responses on a Likert scale ranging from strongly disagree to strongly agree.

Six hundred pharmacy professionals, including pharmacists, pharmacy residents, pharmacy technicians, and pharmacy leaders, were eligible to participate in the study conducted from September 2022 to February 2023. Participants were recruited through an initial interest survey sent by email to all eligible employees. This email provided study information, including the estimated time commitment, and included a survey to collect demographic data and obtain informed consent. Two weeks before the study's closure, a reminder email was sent to participants who had not yet completed their assigned modules.

Participants unable to commit to the entire study duration were excluded and continued with traditional educational modules. The primary investigator used Microsoft Excel (version 16.80) to randomly assign eligible participants to either the control group (receiving traditional education modules) or the intervention group (receiving gamified modules). Three educational modules were selected for gamification based on historically low post-module assessment scores: (1) Aseptic Technique and Infection Control; (2) Controlled Substance Discrepancies and Resolutions; and (3) Pharmaceutical Waste Compliance Programme.

Gamified modules incorporated game design elements like feedback questions, progress tracking, and timed, competitive games while maintaining the same content as traditional modules. The mobile learning management system EdApp was utilised to create and administer these gamified modules. The first author developed all the gamified modules, which were then reviewed and tested by co-authors for functionality and accuracy. Participants could take their modules any time during the five-month window of September 2022 to February 2023, with each module requiring completion in one sitting. The study was stopped in February to allow time for data analysis and possible training changes, if any, before the next training cycle. For the control group, the existing web-based portal was used to deliver the modules via a timed slideshow format with limited interaction, only allowing learners to advance through the slideshow once a timer expired. Immediately after module completion, employees in both groups took an identical, one-time assessment test with a minimum passing score of 80%. The number of post-test questions varied among modules, ranging from 5 to 30. All assessments and subsequent data points were administered and collected via REDCap (version 022023). Satisfaction surveys were administered after each module to evaluate quality, engagement, content, ease of use, and enjoyment.

Statistical analysis

All participants who completed the required post-module assessments and satisfaction surveys were included in the statistical analysis. Using the Qualtrics XM sample size calculator (version 122023), a sample size of 83 subjects per study group (166 total participants) was determined to achieve a 95% confidence interval with a 5% margin of error. Statistical analysis included a Shapiro-Wilk test for normality of distribution. Due to non-normally distributed data for each objective, non-parametric tests were used. These included a Chi-square test to detect differences in assessment pass rates as a percentage, a Wilcoxon signed-rank test to analyse post-module median test scores and satisfaction scores between the two groups, and a Mann-Whitney U test for non-parametric continuous data, such as years of

pharmacy experience. Interquartile ranges were used when median values were reported. The university's institutional review board determined the study to be exempt from board review.

Results

Of the 600 pharmacy professionals invited, 72 (12%) joined the study by March 1, 2023. The sample comprised 55 pharmacists (76%) and 17 technicians (24%). Table I displays the demographics of the control group, gamification group, and total study population. The control group had a higher percentage of technicians compared to the gamification group (30.6% vs 16.7%). Primary pharmacy practice areas and pharmacists' roles are presented in Table I.

The control group had a higher median of years of pharmacy experience, while the gamification group had more years of pharmacy experience specific to TCH. Participants working with the inpatient pharmacy setting accounted for 73.6% of the total sample. No statistical differences in age, TCH experience, or cumulative pharmacy experience were noted between the control and gamification groups.

Table I: Baseline demographic characteristics of participants

	Total population N = 72	Control group n = 36	Gamification group n = 36	*p-value*
Role, n (%)				
Pharmacist	55 (76)	25 (69.4)	30 (83.3)	
Pharmacy technician	17 (24)	11 (30.6)	6 (16.7)	
Age, in years, median (IQR)	36 (32–44)	36 (30–46)	36 (33–43)	0.904
Cumulative experience, median years (IQR)	10 (6–16)	10.75 (5–16)	9.5 (7–16)	0.539
Experience at institution, median years (IQR)	6 (3–7)	4.5 (3–7)	7 (5–7)	0.082
Pharmacist roles, n (%)				
Staff pharmacist	29 (53)	14 (56)	15 (50)	
Clinical pharmacy specialist	15 (27)	5 (20)	10 (33.3)	
Pharmacy resident	5 (9)	2 (8)	3 (10)	
Pharmacy leadership	2 (4)	1 (4)	1 (3.3)	
Other[a]	4 (7)	3 (12)	1 (3.3)	
Primary pharmacy area, n (%)				
Inpatient	53 (73.6)	24 (66.7)	29 (80.6)	
Outpatient	7 (9.7)	6 (16.7)	1 (2.8)	
Other[b]	12 (16.7)	6 (16.7)	6 (16.7)	

[a] Ambulatory, Informatics, Controlled substance
[b] Specialty, Controlled substance team, Informatics team
Abbreviations: IQR, interquartile range

The cumulative median assessment score for both groups was 80%. Table II describes module assessment performance. Median assessment scores for individual modules differed statistically between the two study groups. For the Aseptic Technique and Infection Control module, the control group had a higher median score (90%) compared to the gamification group (84.5%). However, the gamification group exhibited higher median post-module assessment scores for both the Controlled Substance Discrepancies and Resolutions and the Pharmaceutical Waste Compliance Programme modules. The gamification group showed narrower interquartile ranges for all modules except the Controlled Substance Discrepancies and Resolutions module, where no differences were observed.

Participants in the gamification group had higher first-attempt pass rates in two of the three modules. A higher percentage of participants passed the Aseptic Technique and Infection Control module on the first attempt, aligning with the higher assessment scores in the control group. The differences in first-attempt pass rates were not statistically significant for any of the three modules (Table II).

Table II: Module assessment analysis by group

	Control group	Gamification group	*p-value*
Module assessment scores, median (IQR)	80 (70–96)	80 (77–90)	
Aseptic technique and infection control	90 (80–94)	84.5 (80–88)	<0.0001
Controlled substance discrepancies and resolutions	80 (80–100)	100 (80–100)	<0.0001
Pharmaceutical waste compliance program	67 (57–77)	73 (67–79)	<0.0001
Module assessment – First attempt pass rate, n (%)	61 (56)	60 (55)	
Aseptic technique and infection control	24 (67)	18 (50)	0.151
Controlled substance discrepancies and resolutions	28 (78)	32 (89)	0.206
Pharmaceutical waste compliance program	9 (25)	10 (28)	0.789

Abbreviations: IQR, interquartile range

Figure 1 visualises post-module satisfaction scores from participants in each group by module. Overall, the gamification group exhibited higher satisfaction scores compared to the control group. A higher percentage of participants in the gamification group responded with "*agree*" or "*strongly agree*" to all five satisfaction survey questions. Notably, for the Pharmaceutical Waste Compliance Programme module, none of the control group strongly agreed it was enjoyable, while nearly 20% of the gamification group did.

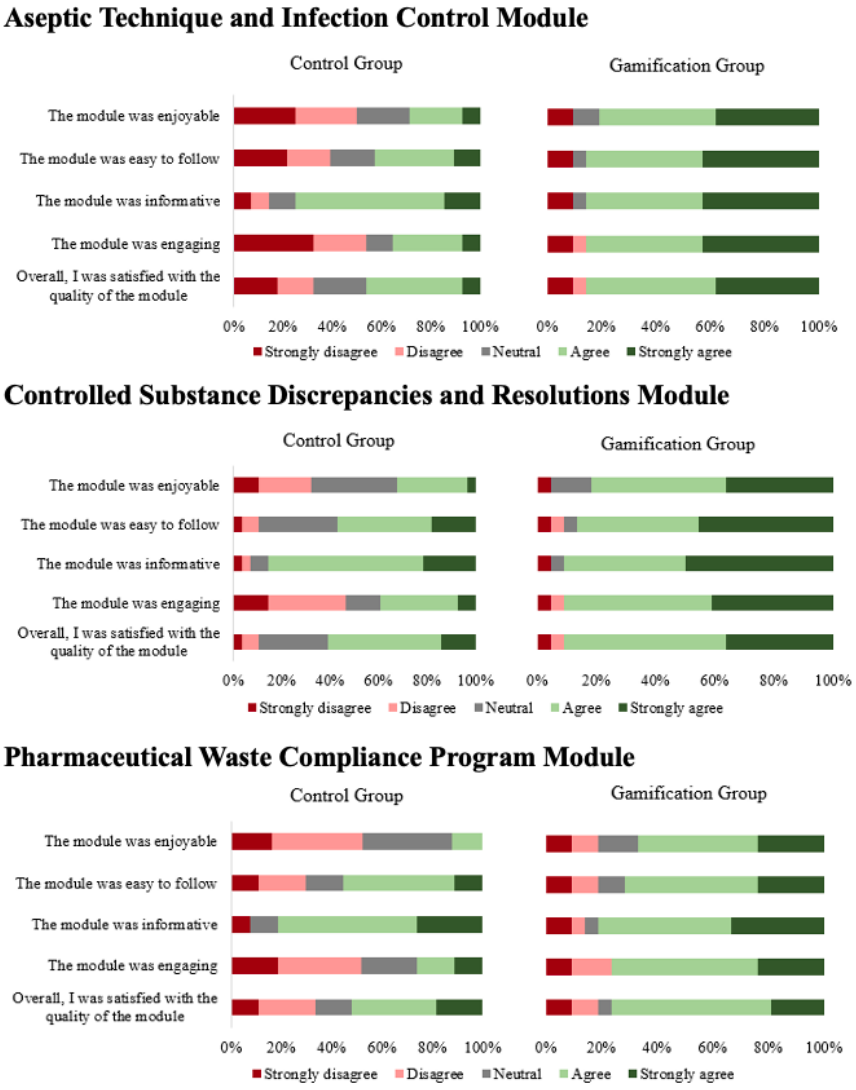

Figure 1: satisfaction survey results by module

For the statements "*the module was engaging*" and "*the module was enjoyable*," the control group had a median score of 4 (agree), while the gamification group showed a higher median score of 5 (strongly agree). These differences in overall median scores were statistically significant for both statements ($p < 0.0001$). No differences were observed in overall median scores for the remaining three satisfaction survey questions.

Using the EdApp platform, the gamification group had average completion times of 15 minutes for the Pharmaceutical Waste Compliance Programme and Controlled Substance Discrepancies and Resolutions modules and 22 minutes for the Aseptic Technique and Infection Control module. Completion times for the traditional modules in the control group could not be measured due to software limitations.

Discussion

This study yielded mixed results in academic performance, with the gamification group showing improved post-module assessment scores in two of the three modules, while consistently demonstrating higher user satisfaction across all three modules. Several factors within the study population and design may account for these mixed academic results. Most participants worked in an inpatient pharmacy setting, with more inpatient pharmacy technicians in the control group than in the gamification group. This disparity could explain the control group's higher assessment scores in the Aseptic Technique and Infection Control module, as technicians typically perform these tasks nearly every shift. At TCH, staff pharmacist roles encompass operational and clinical responsibilities, including medication preparation, order verification, and clinical decision-making. The gamification group comprised more clinical pharmacy specialists (CPSs) than the control group. While CPSs undergo annual aseptic technique competency assessments, they rarely perform these duties routinely. The specific distribution of pharmacist roles was not controlled for during randomisation, nor were pharmacy technicians' roles further delineated. It can be theorised that the control group's higher scores on aseptic technique education reflect a higher proportion of individuals who performed these tasks daily. A secondary analysis identifying whether the control group favoured pharmacists primarily working in medication preparation areas may provide additional insight into this observation.

The assessment results for the Pharmaceutical Waste Compliance Programme and the Controlled Substance Discrepancies and Resolutions modules support the notion that gamification may positively impact academic performance. The gamification group exhibited narrower interquartile ranges for two modules, indicating that participants' assessment scores were closer in range. Operationally, this reduced variability in assessment scores could be advantageous when utilising gamified modules. With less dispersion in results, efforts can be directed towards elevating the collective group's performance, potentially reducing the focus on low-performing outliers.

The modules chosen for gamification for this study historically had low average pass rates, requiring three to five attempts for completion. Since previous pass rates comprised multiple attempts, they could not be directly compared to the one-time assessment scores in this study. This limitation was addressed by implementing a control group, allowing for more appropriate score analysis between groups. First-attempt pass rates for the control and gamification groups were assessed and analysed in place of historical average pass rates. In two of the modules, a higher number of participants in the gamification group passed on the first attempt, although this difference was not statistically significant. Since these modules historically required multiple attempts to achieve a passing score, the impact of gamification on first-attempt pass rates is a notable finding. These results suggest that gamification strategies have the potential to reduce the number of re-attempts needed for employees to achieve a passing score and, thus, institution-deemed competency. The value of this assessment lies in its potential to decrease the time employees spend retaking these modules to achieve passing scores.

The reason for the longer completion time for the Aseptic Technique and Infection Control module remains unclear and warrants further investigation to assess its impact on the lower assessment scores in the gamification group. TCH's inpatient pharmacy areas operate in high-paced environments with limited dedicated downtime for educational module completion. Although a direct comparison to traditional modules is lacking, the relatively quick completion of gamified modules is promising. The fast-paced work environment might have influenced participants' completion times, as they may have had limited opportunities for dedicated module completion during their shifts. Further time studies are needed to conclude if the gamified method of delivery yields more efficient learning for pharmacy personnel. The implications of these time analyses may be valuable for the department's future efforts to maximise pharmacy personnel's time.

This study did not assess the quality of the module material regarding its educational objectives. Both groups showed poor scores in the Pharmaceutical Waste Compliance Programme assessment, suggesting a misalignment between educational material and assessment questions. The educational content remained unchanged between the control and gamified modules to eliminate potential confounders. Participants' answers to the statement "*the module was informative*" showed no difference in median scores, indicating no variance in their perception of the content. This result was expected, as the modules should be equally informative due to the unchanged content across groups. This study primarily aimed to assess the impact of gamification as a key modifiable factor. While the number of interactive elements varied between the three gamified modules, all utilised the same types of elements. Consequently, the improvement in assessment scores and first-attempt pass rates may be attributed to the interactive elements supplied via gamification techniques, as these were the only differing factors between the control and gamified modules.

While the study's primary outcome focused on assessment scores, the satisfaction survey results provided valuable insights into participants' opinions. Participants in the gamification group had a more positive reaction to their modules compared to the control group. Responses in the gamification group were less varied and tended towards positive responses of "*agree*" and "*strongly agree*." The fact that some members of the gamification group answered negatively on the satisfaction survey was expected, as the impact of gamification is entirely dependent on individual preferences. Collectively, the gamification group experienced higher satisfaction scores with their assigned modules. Further analysis of the elements that contributed to increased engagement and enjoyment would be beneficial for future improvements in pharmacy educational modules. While it can be inferred that gamification strategies generally yield more positive user satisfaction responses, it cannot be determined which components are the most impactful. In future studies, more detailed satisfaction survey questions may produce results allowing for the implementation of more specific gamification strategies.

The true benefit of gamification emerges through participants' responses to module enjoyment and engagement, arguably two of the most vital measures in this study. The satisfaction survey results echo similar findings in the published literature (Telner *et al.,* 2010; Nah *et al.,* 2013). Increased user engagement and intrinsic motivation are particularly valuable given the current attitudes towards educational modules in the department. These educational modules, used annually to ensure pharmacy department competency, can be enhanced by gamification strategies. By incorporating gamification, pharmacy departments can engage staff more effectively while making the process of maintaining required competencies more enjoyable.

Limitations

Several limitations of this study should be addressed. While the predetermined sample size was not met, the results still provide valuable operational insights into the pharmacy personnel's perspectives on educational series. This study benefited from taking place in a large academic medical centre with an expansive pharmacy department. The fast-paced pharmacy environment could have also influenced the results, as employees are not given dedicated time to complete required training, often juggling module completion with their daily responsibilities. The lack of blinding and the known identity of the module creator introduce risks of the Hawthorne effect among participants and observer bias in the study team. This study aimed to mimic the reality of completing an educational module in the current work environment. While the improvement in assessment scores was not as robust as anticipated, confounders such as the lack of stratification based on job functions during the randomisation process may have contributed to the primary outcome. Nevertheless, the results still support a degree of improved academic performance. Knowledge retention and role-based results were not assessed, presenting opportunities for future studies. The substantial increase in user satisfaction, enjoyment, and engagement among the gamification group should be considered when developing upcoming educational modules within pharmacy departments.

This study could change TCH's pharmacy department's approach to professional education and may lead to a revamp of the traditional modules utilised by the organisation. It contributes a unique perspective and provides valuable insights into hospital pharmacy department training and education by adding to the limited body of literature surrounding gamification's effects on the academic performance of learners in professional workplace environments. Gamification may enable health systems to educate their workforce to meet accreditation standards and improve satisfaction among team members for required training and education. As non-traditional teaching methods gain popularity in conventional educational settings, the application of gamification may serve as a valuable tool to better engage pharmacy professionals in educational modules (Safapour *et al.,* 2019).

Conclusion

In conclusion, the impact of gamification on pharmacy department education yielded mixed but overall beneficial results in academic performance and user satisfaction. Gamified modules, compared to traditional ones, resulted in higher assessment scores and first-attempt pass rates in two of the three modules. Participants receiving gamified pharmacy educational modules exhibited higher enjoyment and engagement levels compared to those receiving traditional educational modules. The positive influence of gamification observed in this study is encouraging and supports the use of this novel method of educational delivery for pharmacy professionals.

Data availability

The data underlying this article cannot be made publicly available because the study's institutional review board protocol does not permit this specific use of the data.

Disclosure statement

During the preparation of this work, the authors used OpenAI ChatGPT (v3.5, October 2023) to improve the readability of the manuscript and reduce the word count. After using this tool, the authors reviewed and edited the content as needed. They take full responsibility for the content of the publication.

Conflict of interest

The authors declare no conflict of interest.

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Ethics approval

The University of Houston Institutional Review Board has reviewed this project and determined the study to be exempt from review (STUDY00003954). Participants gave informed consent prior to taking part.

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