Pharmacy Education (2026) 26(1) 367 - 374
https://doi.org/10.46542/pe.2026.261.367374

RESEARCH ARTICLE

Evaluating the impact of interactive quiz games in neurology therapeutics on engagement and clinical reasoning among third-year MPharm students

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Keywords
Clinical reasoning
Gamification
Interactive learning
Neurology therapeutic
Pharmacy education

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Abstract

Background: Neurology therapeutics in MPharm programs face challenges in student engagement and case-based assessment performance. Students desire immediate feedback and diverse learning methods. This study evaluated the impact of interactive quiz games on engagement and clinical reasoning among third-year MPharm students in neurology therapeutics. **Methods:** A quasi-experimental study was conducted with third-year MPharm students in a neurology therapeutics course. The intervention used structured quiz games on the Wayground platform, featuring gamification, clinical-scenario questions, and immediate feedback. Data collection included quantitative measures (engagement metrics, pre-post assessments) and qualitative measures (student surveys, staff reflections). **Results:** Strong participation was noted across three sessions (40-64 students per quiz), with clinical reasoning accuracy improving significantly: Session 1 saw a 30% increase (32% to 62%, p=0.0004, Cohen's h=0.61), Session 2 a 19% increase (28% to 47%, p=0.02, Cohen's h=0.40), and Session 3 a 28% increase (22% to 50%, p=0.0057, Cohen's h=0.60). Post-intervention surveys showed 92% of students found the platform engaging, 88% valued the immediate feedback, and 90% felt their clinical reasoning skills improved. Staff noted enhanced student confidence and peer collaboration. **Conclusion:** Interactive game-based quizzes improved student engagement and clinical reasoning in neurology therapeutics education. The intervention showed significant statistical and educational benefits over multiple sessions, with positive feedback from students and staff on its value.

Introduction

Case-based learning effectively helps pharmacy students bridge the gap between theoretical knowledge and scenario-based clinical decision-making, providing context and therapeutic choices from which students can select the best options (Taesotikul *et al.*, 2023). Therapeutic choices inform decision-making skills by processing information and making assessments rather than focusing solely on gathering information (Walker *et al.*, 2023). Clinical reasoning skills can be taught through an engaging, structured approach that combines interactive gamification with immediate feedback, enhancing pharmacy students' competency (Wright *et al.*, 2019).

Neurology therapeutics offered in the MPharm programme cover extensive clinical content but encounter challenges in understanding complex neurological cases, as well as limited interactive learning opportunities and inconsistent performance in case-based assessments. Students stressed the importance of immediate feedback on their therapeutic decisions and the need for varied delivery methods in the learning process (Alkhiyami *et al.*, 2024). Building on the overall module observations, research indicates significant challenges in pharmacy student engagement with complex clinical content, where students frequently encounter uncertainty due to patient complexity, risk assessment, and insufficient information, which points to the importance of

improved educational strategies that connect theory with real-world application (Charrois & Sewell, 2023).

The enhancement intervention involves implementing game-based interactive quizzes on the Wayground platform (formerly Quizizz) to transform case-based learning in neurology therapeutics for MPharm students. This approach uses digital gamification to address engagement and performance challenges in complex clinical learning scenarios. The literature suggests that such a tool is effective in enhancing students' engagement and motivation in pharmacy education (Dabbous *et al*., 2023). The platform demonstrated the potential to enhance student engagement, provide immediate and interactive feedback, create a dynamic learning environment, and improve knowledge retention and clinical reasoning skills (Liu *et al*., 2025).

Focusing on neurology therapeutics, this interactive platform enables users to create customised case scenarios. It provides immediate feedback, fostering an engaging and competitive learning environment (Mohamad *et al*., 2020). Integrating game-based learning into pharmacy education has been shown to increase student motivation and engagement, improve knowledge retention, enhance critical thinking skills, and provide adaptive learning experiences (Sarker *et al*., 2019). The design of this structured learning enhancement project involves scenario-based clinical cases, game-based, engaging, and interactive quizzes, immediate feedback on clinical reasoning performance, and access to competitive leaderboard options. The purpose of this study was to assess the impact of a structured, interactive quiz game on student engagement and clinical reasoning in case-based learning in neurology therapeutics among third-year MPharm students. The study also aimed to gather students' and staff's experiences and reflections on this intervention.

Methods

Study design

This study employed a quasi-experimental single-cohort pre-post design to evaluate the impact of a structured interactive quiz game on student engagement and clinical reasoning in neurology therapeutics among third-year MPharm students. The intervention was implemented as part of an integrated clinical module focused on neurology therapeutics.

Participants

The study included third-year Master of Pharmacy (MPharm) students enrolled in the integrated clinical module focused on neurology therapeutics (N=75). All students were invited to participate voluntarily with no penalties for non-participation. Participation was entirely voluntary, with no compensation offered.

Intervention design

A structured interactive quiz game offered through the Wayground platform was explicitly developed for neurology therapeutics, incorporating several key features designed to enhance student engagement and decision-making skills:

- Gamification elements: Interactive leaderboards, timers, and competitive scoring systems
- Clinical scenario-based questions: Multiple-choice questions derived from complex neurology case studies
- Immediate feedback mechanism: Real-time feedback on therapeutic decisions with explanatory content
- Customisable content: Neurology-specific case scenarios tailored to course learning objectives

The primary outcome, clinical reasoning, was operationalised through the students' accuracy in these complex quiz scenarios. While quiz accuracy serves as a proxy, the parallel cases were specifically designed to demand the synthesis of patient-specific variables, risk assessment, and therapeutic guidelines, thereby measuring applied clinical reasoning rather than short-term factual recall. All quiz responses were submitted individually by students on their own devices, but class accuracy was calculated as an overall group value. The quizzes were strictly formative and did not contribute to the students' final module marks.

Data collection methods

Data collection was mainly based on engagement metrics derived from platform analytics, tracking participation rates and the performance assessment of pre- and post-intervention measures of accuracy in clinical reasoning for the same group of students, reported as a collective class accuracy percentage. At the end of the three sessions, student Feedback was assessed through a short post-intervention survey offered on the platform to capture student perspectives on usability and the learning experience. Draft of the after-intervention survey is provided in Appendix A.

Ethical considerations

The study protocol received ethical approval from the Learning Enhancement Directorate Ethics Filter Committee (Project number: LEDFC-25-001-B). It followed established ethical principles for educational research. Explicit digital informed consent was obtained from all participants prior to data collection. The study fully complied with UK General Data Protection Regulation (GDPR) guidelines regarding the collection, anonymisation, and secure storage of student performance data and platform analytics.

Data analysis

Quantitative data were analysed using descriptive and inferential statistics. Because the platform assigned randomised nicknames to students to maintain anonymity, individual pre- and post-intervention scores could not be paired. Therefore, an independent two-proportion z-test was utilised to compare the aggregate accuracy proportions between the pre- and post-intervention cohorts. Effect sizes for these proportional differences were calculated using Cohen's h, with values of 0.2, 0.5, and 0.8 interpreted as small, medium, and large, respectively. Statistical significance was set at $p < 0.05$. Qualitative data from open-ended survey responses and staff reflections were analysed using an inductive, thematic approach. To ensure analytic rigour, two independent researchers coded the textual data to develop a standard codebook. Inter-rater reliability was established through the discussion of conflicting codes until a consensus was reached. Coding continued iteratively until theoretical saturation was achieved, ensuring the final themes accurately represented the breadth of participant experiences.

Results

Participant engagement and completion rates

Out of the 75 enrolled students, the intervention demonstrated strong participation across the three sessions. Analysis of the quiz completion data revealed that 40 to 64 individual students completed the quizzes. There was a relatively higher participation rate in the pre-session quizzes (Session 1: n=64; Session 2: n=56; Session 3: n=48) compared to post-session quizzes (Session 1: n=57; Session 2: n=51; Session 3: n=40). The unit of measurement remained strictly individual throughout; the decline in post-quiz numbers reflects natural attrition, with a subset of students leaving the session early or failing to log back into the platform. Engagement metrics indicated that students spent an average of 1.4 minutes per clinical case before submitting a decision.

Clinical reasoning performance

Pre- and post-intervention analyses using independent two-proportion z-tests revealed significant improvements in the cohort's aggregate clinical reasoning accuracy across all three sessions.

- Session 1: The pre-intervention baseline accuracy was 32%, which increased to 62% following the intervention, reflecting a 30% absolute improvement ($p = 0.0004$, Cohen's $h = 0.61$).
- Session 2: The pre-intervention baseline accuracy was 28%, which increased to 47% following the intervention, reflecting a 19% absolute improvement ($p = 0.02$, Cohen's $h = 0.40$).
- Session 3: The pre-intervention baseline accuracy was 22%, which increased to 50% following the intervention, reflecting a 28% absolute improvement ($p = 0.0057$, Cohen's $h = 0.60$).

Across all three cohorts, the proportion of correct responses increased by approximately 20-30 percentage points after participating in the interactive Wayground session. Effect sizes indicate practically meaningful improvements despite progressively more complex prescribing scenarios being introduced in later sessions. Collectively, these findings demonstrate a statistically robust enhancement in aggregate clinical reasoning performance. Figure 1 illustrates the accuracy of clinical reasoning before and after the three sessions.

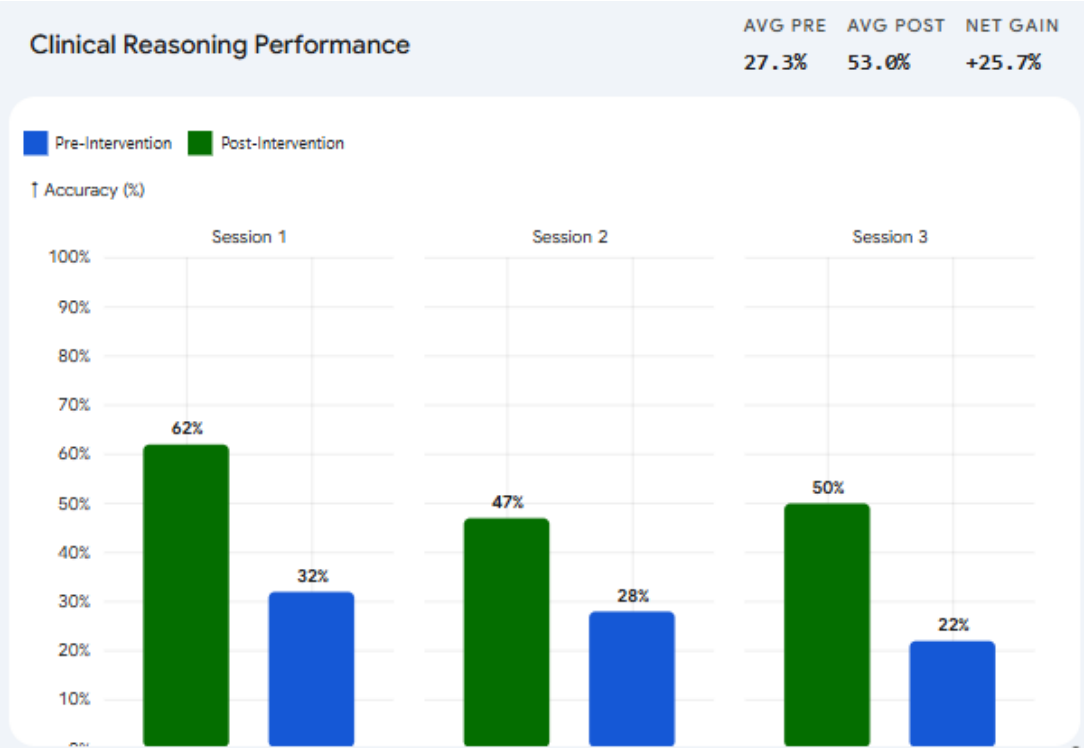

Figure 1: Clinical reasoning accuracy before and after the sessions.

Student experience and staff reflections

The post-intervention survey achieved a high response rate, with 59 of 64 eligible participants completing the instrument (92%). Quantitative survey results revealed high student satisfaction with the Wayground platform:

- **92%** (n=54/59) indicated the platform was "*engaging and interactive*."
- **88%** (n=52/59) appreciated the immediate feedback feature for clarifying misconceptions.
- **90%** (n=53/59) felt their clinical reasoning skills had improved as a result of the activities.

Thematic analysis of the open-ended survey responses and staff reflections identified three primary themes regarding the intervention's impact:

- **Enhanced Cognitive Engagement:** Students frequently noted that the gamified format forced them to focus more intently on patient parameters than traditional didactic formats. One student remarked, "*The timer made me actually commit to a therapeutic choice rather than just passively waiting for the lecturer to give the answer*."
- **Value of Immediate Feedback:** Both students and staff highlighted the importance of real-time correction for addressing clinical blind spots. A student noted, "*Seeing exactly why my drug choice was contraindicated immediately after I selected it helped the concept stick much better than reviewing notes later*."
- **Gamification as a Motivator (with caveats):** While the competitive elements drove participation, they also prompted collaboration. Staff observed the unexpected formation of informal study groups, where students collaboratively debated cases before submitting individual answers. A staff member reflected, "*There was a noticeable increase in vocalised clinical reasoning; students were actively debating the guidelines with their peers to ensure they placed high on the leaderboard*." However, a minority of feedback noted time pressure.

Teaching staff reported that while the initial scenario design required a substantial time investment, tracking student progress through platform analytics enabled them to efficiently identify and address class-wide knowledge gaps in real time. Staff also observed marked improvements in student confidence during subsequent verbal case discussions, indicating effective transfer of learning from the digital platform to face-to-face interactions.

Discussion

This work represents an endeavour to systematically integrate gamification elements into quizzes used during neurology therapeutics clinical learning sessions. The approach has been implemented over three consecutive iterations to evaluate its impact while allowing for observation and reflection. An interactive, game-based quiz featuring ten brief clinical cases was administered both before and after the three sessions. The pre-session quiz was designed to emphasise key learning points, establish a baseline of knowledge, and encourage interactivity at the start of the session (Han & Klein, 2019). The post-session quiz, conducted at the educator's pace, provided immediate feedback on each case, with a focus on comparing results to the baseline assessment. Both quizzes were facilitated through the Wayground platform (formerly Quizizz), which presents quizzes in a game format with options for customisation, engaging names, leaderboard competition, and accuracy assessments for each clinical case (Liu *et al*., 2025).

Student engagement and feedback

These findings indicated a positive trend in student engagement, as evidenced by high participation rates throughout the activities. However, there was a noticeable decline in participation during the post-session quiz. This decline may be due to how participants were grouped when answering cases after the session, potentially resulting in multiple users being counted as a single participant on the platform. Additionally, the quantitative data revealed that students perceived the intervention as engaging and interactive. They appreciated the opportunity to receive immediate feedback on their clinical reasoning, along with clear guidance on areas for improvement and focus. This finding aligns with previous research suggesting that online quizzes are a beneficial approach for facilitating learning, stimulating interest, and consolidating knowledge (Sarker *et al*., 2019).

Qualitative insights further contextualised this data, revealing that the time constraints of the gamified platform actively discouraged passive learning, compelling students to commit to and defend their clinical choices. In the qualitative feedback from students, they expressed largely positive input, emphasising aspects of engagement, interactivity, and learning support gained from learning from mistakes. This also aligns with previous evidence showing that healthcare students perceived the game-based quizzes positively, in a manner that correlates with their game scores Noordin *et al*., 2023). However, a few comments also highlighted the time challenge in addressing the entire set of clinical cases, suggesting that the time allocated for the overall activity be extended.

While gamification and competitive leaderboards were found to drive engagement, it is important to acknowledge their potential psychosocial implications. Competitive elements may induce test anxiety and stress for lower-performing students, potentially leading to disengagement (Schlömmer *et al*., 2021). Future iterations must carefully balance these competitive features with collaborative learning opportunities to ensure an inclusive educational environment.

Impact on clinical reasoning

The intervention primarily aimed to enhance students' clinical reasoning by providing clinical cases both before and after the session, along with immediate feedback during the post-session quiz. It was believed that comparing responses and incorporating feedback would positively influence clinical reasoning (Charrois & Sewell, 2023). Additionally, the gamification element introduced an enjoyable and engaging aspect to clinical learning, fostering an environment where peer learning flourished (Liu *et al*., 2025). Students were encouraged to form groups to discuss their responses to the cases presented on the platform. Overall, the use of instruction-based educational games in pharmacy education is thought to enhance learning and help achieve competencies (Dabbous *et al*., 2023). Clinical reasoning is the cognitive process that enables pharmacists to apply skills related to information gathering, pattern recognition, critical thinking, and prioritisation to assess drug therapies, identify medication-related problems, and make safe, evidence-based decisions to improve health outcomes (Tietze, 2019). Consequently, this enhancement intervention provides 10 diverse sets of clinical cases in each session to facilitate learning and assessment of clinical reasoning.

Staff reflections

Staff involved in implementing the intervention noted that providing immediate feedback effectively closed knowledge gaps and encouraged further enquiries, thus enhancing clinical learning (Liu *et al*., 2025). Additionally, the emergence of unexpected peer collaboration through study groups proved to be a valuable secondary outcome that deserves further exploration in future iterations of the intervention. A previous case report in the US highlighted that Peer teaching has a positive impact on teaching and learning related to pharmaceutical care among pharmacy students (Kolar *et al*., 2018). Ultimately, gamification is regarded as an engaging and enjoyable approach to

teaching and learning in pharmacy education (Sera & Wheeler, 2017). However, it requires careful design to tackle challenges, such as allocated time, potential technical issues, and the chance to implement it in an organised manner.

Recommendations and future directions

Future implementations should prioritise comprehensive pre-session platform testing and establish standardised technical protocols to minimise disruptions. Creating a central repository of validated neurology case scenarios with varying levels of complexity would enhance efficiency and enable tailored content delivery. Maintaining anonymous leaderboard options remains essential for inclusive learning environments. The intervention design should strike a balance between competitive and collaborative elements by incorporating both individual and team-based formats to accommodate diverse learning preferences. Addressing time constraints by extending session durations or adopting adaptive pacing would improve the students' experience while maintaining educational rigour. Systematic integration of gamified quizzes within the broader assessment framework could enhance motivation and provide valuable formative evaluation opportunities. Future research should investigate the long-term retention of clinical reasoning improvements through follow-up assessments at 3-, 6-, and 12-month post-intervention intervals. Comparative effectiveness studies between different platforms and traditional methods would provide evidence-based guidance for selection.

Implications

The consistent improvement in clinical reasoning across all sessions suggests that gamified learning interventions may help bridge the gap between theoretical knowledge and practical application in complex clinical subjects. High student satisfaction rates and positive staff feedback indicate strong acceptability, suggesting that traditional lecture-based approaches could benefit from integration with interactive, technology-enhanced learning methods. The intervention's scalability potential and ease of progress tracking through platform analytics suggest that initial investments in educational technology can yield long-term benefits across multiple cohorts. The successful application in neurology therapeutics indicates potential transferability to other health professional education programmes, particularly those that require clinical reasoning competencies. The emergence of spontaneous peer collaboration and study groups suggests that well-designed, gamified interventions might enhance both individual skill development and collaborative learning behaviours essential to interprofessional healthcare practice. This suggests potential broader applications across healthcare education disciplines beyond pharmacy.

Limitations

A significant limitation of this pre-post study design is the lack of a control group. Consequently, the teaching session itself acts as an uncontrolled confounder, meaning the observed improvements reflect the combined effect of the lecture content and the gamified quiz format. Causality cannot be firmly established, and future studies should employ a randomised controlled trial design with a comparator arm to isolate the platform's effect. Furthermore, the post-intervention survey instrument lacked formal psychometric validation. Additionally, the platform assigned nicknames to students each time they took the quiz to maintain confidentiality, which hindered the ability to compare clinical reasoning at the individual-student level; thus, results could only be reported as aggregate data for the class at a given time. Lastly, no comparisons with other platforms or tools were made during the implementation period, which prevented an evaluation of the chosen platform's efficiency relative to others

Conclusion

This study provides preliminary evidence that integrating interactive quiz games could boost student engagement and clinical reasoning skills in neurology therapeutics education. The positive staff feedback and observed increase in student confidence during face-to-face discussions indicate successful transfer of learning from digital to traditional educational settings. Broadening the perspective, this study adds to the growing body of evidence supporting gamification in health professional education by effectively addressing challenges in student engagement and in the development of clinical reasoning. It indicates that well-designed gamified learning interventions may support improvements in both student engagement and clinical reasoning skills in complex clinical subjects, encouraging further development and integration of such methods in health professional training.

Acknowledgement

This work was undertaken as a school initiative and a learning enhancement project as part of the Higher

Education Practice Fellowship at the University of Ulster, United Kingdom.

Conflict of interest

The authors declare no conflict of interest.

Source of funding

The authors did not receive any funding.

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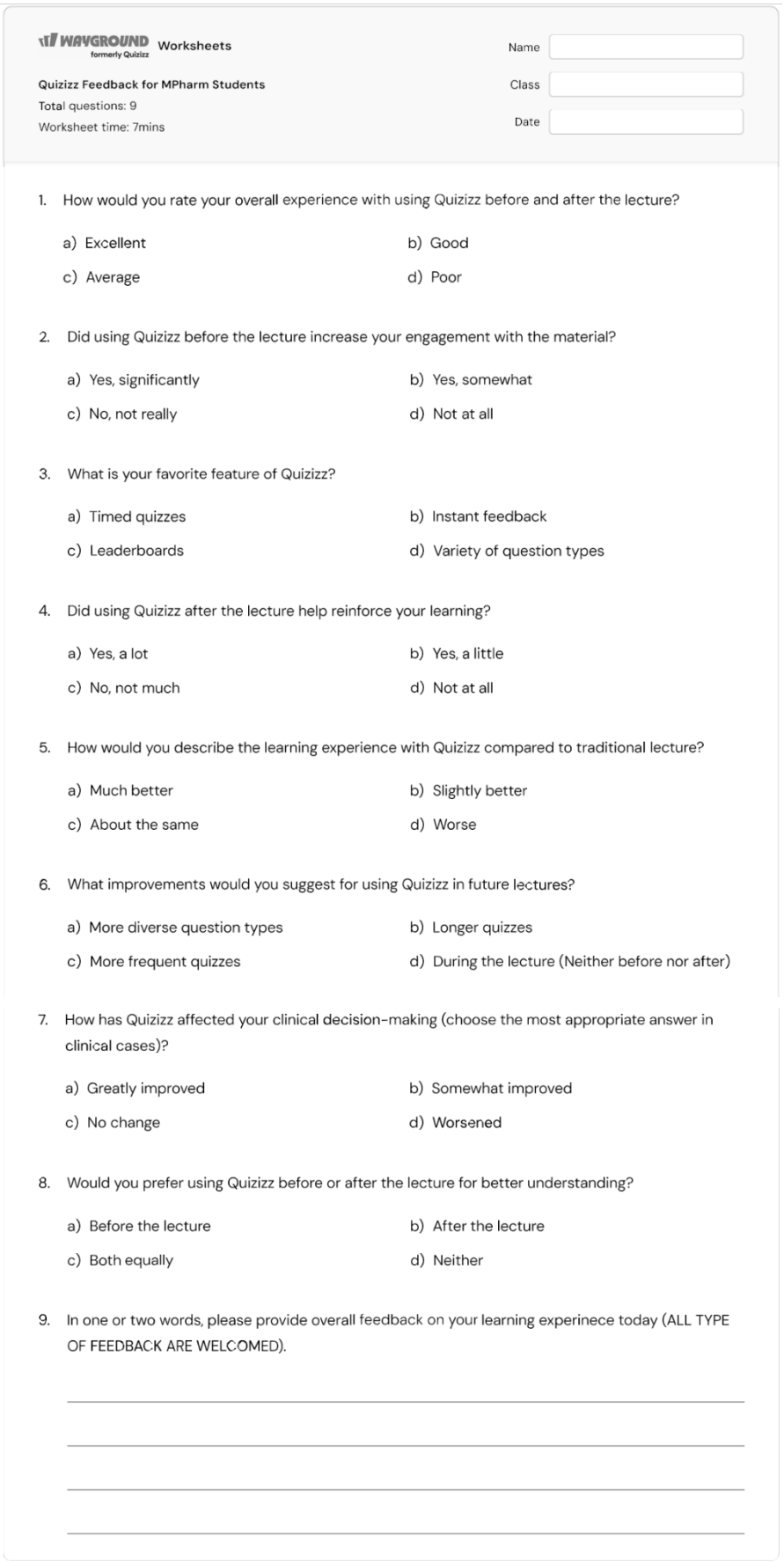
Appendix A: The after-intervention survey



WAYGROUND formerly Quizizz Worksheets

Name

Quizizz Feedback for MPharm Students

Class

Total questions: 9

Worksheet time: 7mins

Date

1. How would you rate your overall experience with using Quizizz before and after the lecture?

   a) Excellent b) Good

   c) Average d) Poor

2. Did using Quizizz before the lecture increase your engagement with the material?

   a) Yes, significantly b) Yes, somewhat

   c) No, not really d) Not at all

3. What is your favorite feature of Quizizz?

   a) Timed quizzes b) Instant feedback

   c) Leaderboards d) Variety of question types

4. Did using Quizizz after the lecture help reinforce your learning?

   a) Yes, a lot b) Yes, a little

   c) No, not much d) Not at all

5. How would you describe the learning experience with Quizizz compared to traditional lecture?

   a) Much better b) Slightly better

   c) About the same d) Worse

6. What improvements would you suggest for using Quizizz in future lectures?

   a) More diverse question types b) Longer quizzes

   c) More frequent quizzes d) During the lecture (Neither before nor after)

7. How has Quizizz affected your clinical decision-making (choose the most appropriate answer in clinical cases)?

   a) Greatly improved b) Somewhat improved

   c) No change d) Worsened

8. Would you prefer using Quizizz before or after the lecture for better understanding?

   a) Before the lecture b) After the lecture

   c) Both equally d) Neither

9. In one or two words, please provide overall feedback on your learning experinece today (ALL TYPE OF FEEDBACK ARE WELCOMED).