Games as homework to promote student engagement in an asynchronous online course

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Many educators find it challenging to engage students in asynchronous online courses.
- Game-based homework, created using Gimkit, is a potentially powerful tool that provides a fun way to engage students in online asynchronous learning.

ABSTRACT

Introduction: Asynchronous online courses are designed to offer flexibility. To promote student engagement, educators at a Canadian university incorporated game-based homework assignments in an online dental hygiene course. **Case description:** A study was conducted to describe student engagement and the impact of this intervention. Student performance data from summative exams and engagement data from the learning management system were analyzed. Results showed that students were highly engaged with the game-based assignments, created using Gimkit, the week before the course summative exams. Students performed significantly better on questions reviewed by the homework assignments compared to the other questions on the exam. **Discussion:** Although the results are from 1 cohort of students, they demonstrate the potential of game-based homework to significantly improve students' learning experiences. **Conclusion:** The increasing popularity of online and hybrid learning necessitates the innovation of new techniques to engage students online; Gimkit can be a powerful and fun tool for this purpose.

RÉSUMÉ

Introduction : Les cours en ligne asynchrones sont conçus pour offrir de la flexibilité. Pour favoriser l'engagement du corps étudiant, les formateurs d'une université canadienne ont intégré des travaux sous forme de jeu à un cours en ligne sur l'hygiène dentaire. **Description du cas :** Une étude a été réalisée pour décrire l'engagement des élèves et l'incidence de cette intervention. Les données sur le rendement des élèves tirées des examens sommatifs et les données sur l'engagement du système de gestion de l'apprentissage ont été analysées. Les résultats ont montré que les étudiants étaient très engagés dans les travaux sous forme de jeu, créés à l'aide de Gimkit, la semaine précédant les examens sommatifs du cours. Les étudiants ont obtenu un rendement nettement supérieur aux questions abordées dans les devoirs comparativement aux autres questions de l'examen. **Discussion :** Bien que les résultats proviennent d'une seule cohorte, ils démontrent le potentiel des devoirs axés sur le jeu pour améliorer considérablement l'expérience d'apprentissage du corps étudiant. **Conclusion :** La popularité croissante de l'apprentissage en ligne ou hybride nécessite l'innovation de nouvelles techniques pour mobiliser les étudiants en ligne; Gimkit peut être un outil puissant et amusant à cet effet.

Keywords: education; educational activities; educational technique; learning; teaching; teaching method
CDHA Research Agenda category: capacity building of the dental hygiene profession

INTRODUCTION

Active engagement with study materials promotes learning.[1,2] Recent studies have identified games as an effective tool to increase student engagement and knowledge retention in health science education.[3] Although most educational games are internet based and played on the computer, they are primarily used in in-person classes.[4] For online courses or online components of blended courses, gamification is still mostly limited to the incorporation of game elements, such as badges, to enhance students' learning experiences,[5] with limited reports on game-based learning designed solely for asynchronous online courses.[6]

Online learning is gaining popularity in health professional education around the world.[7] Asynchronous online courses are specially designed to provide flexibility and self-directed learning. However, engaging students in asynchronous online courses is challenging, with online discussion forums and student groups being some of the few known tools for this task.[8] Online quiz-based games from Gimkit may be a new tool to promote student engagement in asynchronous online courses.

Gimkit is an online platform (gimkit.com/)[9] for creating quiz-based games. Using this platform, instructors can import pre-made question banks or create multiple-choice (MCQ), true/false or short-answer questions from scratch. Questions can include audio and images as well. Once the question set is made, the instructor can convert it into a game-based homework assignment by setting goals for the players to achieve. Gimkit offers 4 game-based homework modes: Fishtopia, Don't Look Down, Cash Tycoon, and Farmchain.[9]

"Fishtopia" is a strategic fishing game in which students

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must answer questions correctly to get bait for fishing and then sell the fish to earn game money. The assignment is completed once the cash goal (set by the instructor) is achieved. Students can strategically invest game money to buy boosters to help them achieve the goal faster. To achieve the goal, students must go through the question sets multiple times, which allows them to reinforce concepts and memorize facts. "Farmchain" is based on a similar theme: students grow crops and sell them to reach the cash goal. In "Cash Tycoon" mode, students must maintain a streak of answering questions correctly to earn game money. A wrong answer to a question makes them lose game money and credits. In "Don't Look Down," students earn energy by answering questions. The energy is invested in jumping and reaching a height goal the instructor sets. Fixed due dates can also be set for these game-based assignments.

Game-based pedagogies can foster a student-centred learning environment. Of the 4 major learning theories, both humanism and constructivism support the importance of learner-centred education.[10] However, identifying 1 suitable theory is difficult, as the nature of the educational game and game-based learning varies widely. The use of game-based homework assignments in education can be supported by the Reinforcement Learning Theory, which suggests that the tendency to perform an action is increased if that action is followed by a reward.[11] The reward for game-based homework in an asynchronous course can be either the intrinsic game element (achieving the goal, levelling up, etc.) or the potential for academic achievement. The willingness to perform better on the exam can be considered a "reward" motivating students to play the games.[12]

Using Gimkit, the authors incorporated game-based learning as supplementary homework assignments into an online asynchronous course in the Dental Hygiene Program at the University of Alberta, Canada. A study was conducted to evaluate the impact of game-based learning materials on student engagement and academic achievement in the course. The research questions were as follows:

1. How do students engage in game-based learning in an asynchronous online course?
2. How does game-based learning impact students' academic achievement in an asynchronous online course?

CASE DESCRIPTION

This research followed a descriptive study design, which systematically describes a population, situation or phenomenon without identifying the underlying cause.[13,14] It aimed to illustrate student engagement and the impact of game-based homework assignments in an asynchronous online dental hygiene course. The University of Alberta Research Ethics Board (REB 2) reviewed and approved this study. The ethics approval ID is Pro00124923.

The dental hygiene program at the University of Alberta offers an oral biology course (OBIOL 202) asynchronously online to second-year students. It is a 2.0 credit, 15-week course covering topics related to hard and soft tissues in the oral cavity and their development. Two vodcast lectures were posted in the learning management system (LMS) each week throughout the winter 2024 semester. Fourteen games with seven sets of practice questions were posted in the LMS as supplementary homework assignments in alternating weeks. Each question set was posted on 2 different game modes to avoid possible boredom for students. The placement of the game-based homework in the course outline is shown in Figure 1.

This study involved 47 second-year dental hygiene students who enrolled in the OBIOL 202 course in the winter 2024 semester. Anonymized student performance data from summative exams and student engagement data from the LMS were collected. Some of the questions included in the supplementary game-based homework also appeared in the summative exams in alternative formats where the wording, format or type of questions were changed. Fifty-two percent (52%, n = 26) of the questions on the midterm exam and 42% (n = 30) of the questions on the final exam were previously included in the game-based homework assignments. The difficulty indices of each question on the midterm and final exams were calculated. The difficulty index of a question refers to the percentage of students who answered that question correctly. A higher difficulty index indicates a better overall performance of the class on that particular question.[15] The questions used in the summative exams were divided into 2 groups: (A) questions from concepts not reviewed by the supplementary game-based homework; (B) questions from concepts reviewed by the supplementary game-based homework. The difficulty indices were compared between the 2 sets of questions. Statistical analyses (2-tailed t-tests) with significance defined as $p < 0.05$ were performed using Microsoft Excel.

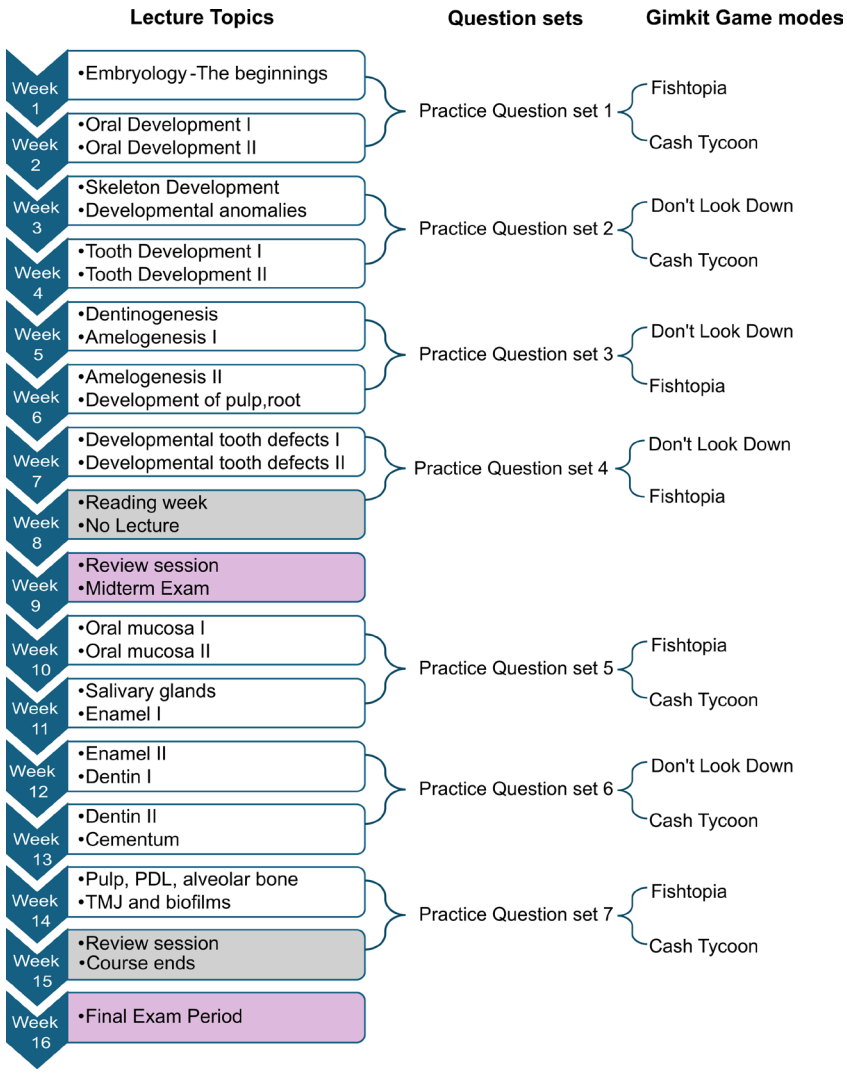
Student engagement data, in the form of the number of interactions with the game-based homework assignments, were analyzed. Pearson's correlation coefficient between student interaction with homework and overall course grade was analyzed using Microsoft Excel. Correlation coefficients indicate the strength of a linear relationship between 2 variables: student engagement and course grade. A linear correlation coefficient greater than zero indicates a positive relationship between the variables. A value less than zero indicates a negative relationship; a value of zero indicates no relationship between the variables.[16]

RESULTS

Student engagement with the game-based homework assignments

Ninety-four percent (n = 44) of the class engaged with the supplementary homework assignments. The highest number of interactions by a single student was 48; the lowest was 3. The number of occurrences of interactions

Figure 1. The placement of game-based homework within the OBIOL 202 course timeline



with the game-based homework assignments was plotted over the course timeline. The highest interactions were observed around weeks 8, 15, and 16 (Figure 2). Week 8 was the reading break for students, with the midterm exam on week 9. Similarly, the final exam of the course was on week 16. Week 15 was the review week before the exam, with no new lectures posted.

Impact of the game-based homework assignments on student academic performance

Student performance was evaluated on the midterm and final exams. The average difficulty index of questions previously reviewed by game-based homework was 92%, significantly higher (p = 0.0000339) than the difficulty index for the group of questions based on concepts that were not reviewed (Figure 3A). Similarly, for the final exam, students performed significantly (p = 0.006) better on questions reviewed by games (93%) compared to the questions whose underlying concepts were not reviewed by homework games (Figure 3B).

Correlation between student engagement with the game-based homework and course grade

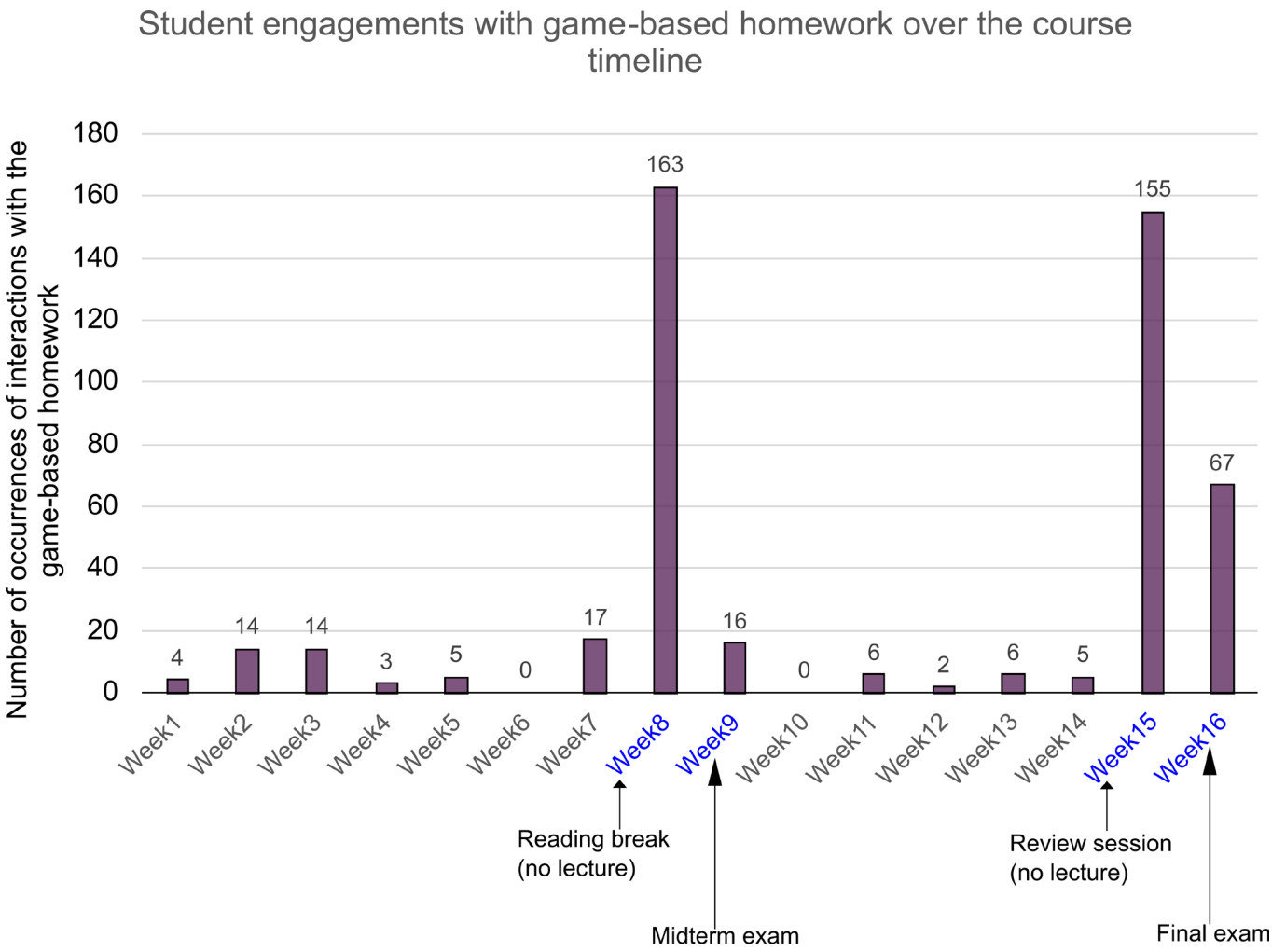
A weak positive linear correlation (correlation coefficient, r = 0.2) was found between student engagement and the overall course grade (Figure 3C).

DISCUSSION

Gimkit is a relatively new platform for hosting quiz-based educational games. This study described the implementation and evaluation of game-based homework assignments created using Gimkit for an asynchronous online oral biology course. The course presents a wide range of concepts on the development of teeth and surrounding oral structures. Game-based homework was introduced into the course to foster student engagement. A study was conducted to evaluate student engagement and the impact of game-based learning on their academic achievements.

Gimkit offers 4 game modes; the study authors chose 3 game modes (Fishtopia, Cash Tycoon, and Don't Look Down) to foster a unique gaming experience for the

Figure 2. Student engagement with the game-based homework assignments over the course timeline



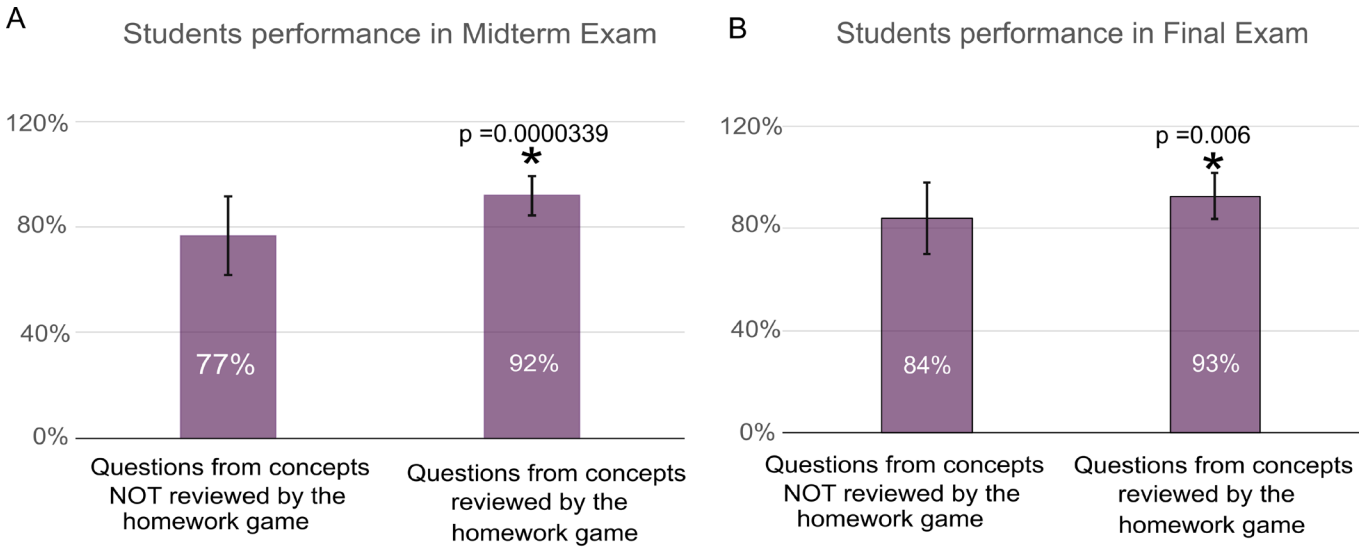
students. As Fishtopia and Farmchain have the same underlying game challenges and goals, only one from that set was chosen. Although the games were posted as supplementary activities, 44 students, 94% of the class, participated. When student engagement with the game was tracked throughout the timeline, a surge of interaction was observed during the reading week and the review week, right before the 2 summative exams. High engagement with the games at those times indicates that students played the supplementary homework game as a tool to review and reinforce their learning. This behaviour is supported by the Reinforcement Learning Theory, where students were motivated by the "reward" of potentially better performance on the exam.[11,12]

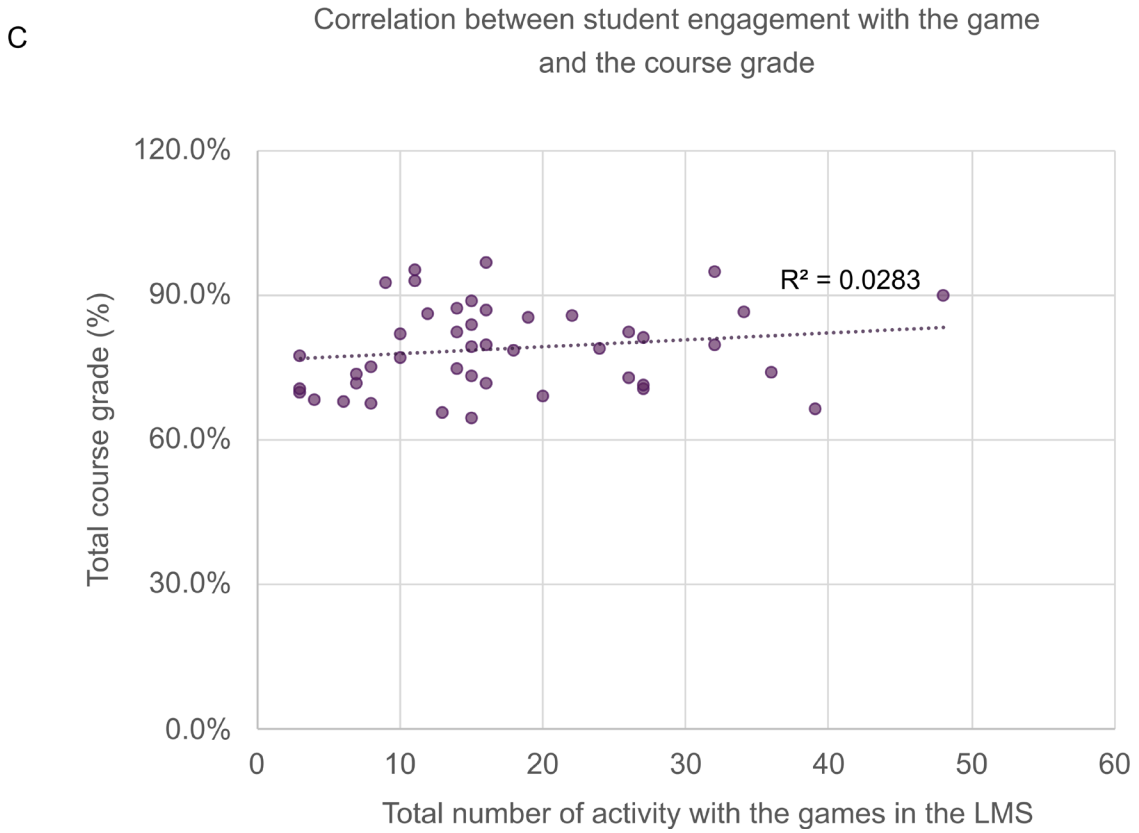
When homework assignments were given, no due date was set and the games were left open until the last day of the course. This provided students with the flexibility to play the game at their own pace. However, setting specific due dates for homework assignments can be an effective tool to create a gated pathway in an online course, where students have to complete certain parts of the course or assignments for the next set of course materials to be available.

This study showed that students performed significantly better on questions addressing concepts reviewed by the gameplay. This finding is aligned with previous studies showing a positive impact of review sessions on students' learning and academic performances.[17,18] Quiz games such as Kahoot! have also been shown to improve student performance and engagement in a histology course.[19]

A strong positive correlation has been reported between student engagement and academic achievement.[20] This study, however, reported a weak positive correlation between student engagement with the game-based homework assignment and the overall course grade. In a study with an online asynchronous course, Hoffman et al.[21] showed that, in addition to the frequency of engagement, regularity and immediacy are essential for student success. In the present study, the highest student interactions were observed during the reading break and before the exam. The lack of regularity in playing games may contribute to

Figure 3. Students' academic performance in the midterm (A) and final (B) exams, and Pearson's correlation coefficient (C) between student interaction with homework and overall course grade





the weak positive correlation between student engagement with the games and the overall course grade.

This study has some limitations. The findings are based on 1 cohort of dental hygiene students, limiting its applicability to broader populations. No demographic data were collected. Student-specific patterns of interaction and the time spent on the games were also not evaluated. Future studies should be undertaken using student interviews to better understand students' experiences with game-based assignments. The engagement data collected from the LMS in the present study did not report the time of engagement. Further studies are needed to analyze student engagement with game-based homework and its impact on students' academic achievement and learning experiences. Aside from these limitations, this study reveals the potential of Gimkit and game-based homework assignments as teaching and learning tools to improve students' learning experiences in online courses.

CONCLUSION

The increased popularity of online and hybrid learning in higher education necessitates the identification of new ways to engage students in online learning, especially in asynchronous courses. Quiz games from Gimkit can be a potential and powerful tool to complement traditional teaching and provide a fun way to engage students with the course materials.

CONFLICTS OF INTEREST

The authors of this study have declared no conflicts of interest.

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