Exploring students' experience with game-based learning: a descriptive study

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PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Creating an engaging and motivating educational game is challenging.
- Game-based learning through Gimkit can motivate students and promote self-determination and meaningful engagement to improve students' learning experiences.

ABSTRACT

Background: Game-based learning aims to promote student engagement and boost motivation in the classroom. However, creating long-term motivation in an education game is challenging and requires a balance between "fun" and "educational" objectives. The gaming platform Gimkit allows educators to create, host, and play quiz-based games in class and host game-based homework in learning management systems. Gimkit was introduced in 2 dental hygiene courses at a Canadian university: one was offered in person; the other was asynchronous online. This study aimed to explore students' perception of game-based learning experiences, their choice of game modes, and their source of motivation. **Methods:** Students from the second and third years of the dental hygiene program were invited to participate in a voluntary online survey to collect their perceptions of either the live quiz game or the game-based homework assignments, their choice of game mode, and their motivation to play. Descriptive statistics were applied to analyze the survey data. **Results:** Thirty-five percent (n = 15) of the in-person class and thirty percent (n = 14) of the online class completed the voluntary survey. All participants from the online and in-person groups strongly agreed that they improved their knowledge by playing the game. **Discussion**: Students were largely motivated extrinsically and played the game to learn course content. Students from the in-person class were driven towards Gimkit live quiz games by in-class competition. For online students, the "challenge of the game" was the most attractive feature of Gimkit. **Conclusion:** Game-based learning with Gimkit can motivate dental hygiene students and promote self-determination.

RÉSUMÉ

Contexte : L'apprentissage par le jeu vise à encourager l'engagement des étudiants et à les motiver en classe. Cependant, il est difficile de susciter une motivation à long terme en utilisant un jeu éducatif et il faut trouver un équilibre entre les objectifs « ludiques » et « pédagogiques ». La plateforme de jeux Gimkit permet aux enseignants de créer et d'animer des jeux et de les jouer sous forme de jeu-questionnaire en classe, et de proposer des devoirs sous forme de jeux dans des systèmes de gestion de l'apprentissage. Le Gimkit a été introduit dans 2 cours d'hygiène dentaire : l'un était dispensé en présentiel, l'autre en ligne de manière asynchrone. Cette étude visait à explorer la perception des étudiants sur les expériences d'apprentissage par le jeu, leur choix de modes de jeu et leur source de motivation. **Méthodes :** Les étudiants de deuxième et de troisième année du programme d'hygiène dentaire d'une université canadienne ont été invités à participer à un sondage volontaire en ligne afin de recueillir leurs perceptions du jeu-questionnaire en direct ou des devoirs fondés sur le jeu, leur choix de mode de jeu et leur motivation à jouer. Des statistiques descriptives ont été utilisées pour analyser les données du sondage. **Résultats :** Trente-cinq pour cent (n = 15) des étudiants en présentiel et trente pour cent (n = 14) des étudiants en ligne ont répondu au sondage volontaire. Tous les participants des groupes en ligne et en présentiel étaient tout à fait d'accord qu'ils avaient amélioré leurs connaissances en jouant au jeu. **Discussion :** Les étudiants étaient largement motivés de manière extrinsèque et jouaient au jeu pour apprendre le contenu du cours. Les étudiants en présentiel étaient motivés à jouer aux jeux-questionnaires en direct Gimkit en raison de la compétition en classe. Pour les étudiants en ligne, le « défi du jeu » était la caractéristique la plus attrayante de Gimkit. **Conclusion :** L'apprentissage par le jeu en utilisant Gimkit peut motiver les étudiants en hygiène dentaire et encourager l'autodétermination.

Keywords: dental education; dental hygiene; educational activities; educational technique; gamification; motivation; online education; online learning; teaching; teaching method

CDHA Research Agenda category: capacity building of the profession

INTRODUCTION

The teaching and learning approaches in health professions education are changing rapidly, driven by the needs of Generation Z students and facilitated by the widespread use of the internet and web-based tools.[1,2] Current students in health professions schools are predominantly from Generation Z (born between 1995 and 2009), with a very different attitude and behaviour from the previous generation. This new generation of students is technology-

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native, fast, and results-oriented.[3] To attract, engage, and motivate these students, many institutions are embracing innovative pedagogy; game-based learning is one of them.[4]

The positive impacts of gamification on knowledge acquisition, motivation, and satisfaction are well established.[5,6] Games can be incorporated into education in 3 ways. First, gamification, which refers to incorporating game elements such as leaderboards and badges to create a gameful experience, can be attained by adding simple activities such as a progress bar or virtual rewards in the learning management system.[7] Second, game-based learning involves using actual educational games in the classroom to improve student motivation and engagement. The online quiz game Kahoot is an example of game-based learning.[8] Third, serious gaming in education combines games with real-world simulations to develop specific skills or competencies.[9] The virtual reality-based advanced cardiac life support training simulator is an example of serious gaming, where each player takes the role of a resuscitation team member to evaluate a virtual patient clinically and resuscitate accordingly.[10]

The overarching goal of gamification is to influence user behaviour through user motivation.[11] The impact of gamification on user motivation can be explained by self-determination theory (SDT).[12] Humans are driven by 2 types of motivation: intrinsic and extrinsic. When intrinsically motivated, a player is driven by the underlying fun or challenge of the game rather than an external influence, pressure or reward.[13] Although avoiding extrinsic motivation entirely is not possible, there are factors that can promote or hinder the internalization and integration of extrinsic motivations, making an individual experience the external motivations as internally caused and thus promoting self-determinedness.[13] Game elements such as rewards and leaderboards have been introduced to help improve students' learning experiences.[4] However, the drawback of any reward-based system is that the player's motivation stops when the reward stops coming.[14] A better approach to fostering long-term motivation and engagement throughout a course would be to design games where students find their own reasons for engaging with the game.[14]

Gimkit (gimkit.com) is a new gaming platform that allows educators to create, share, host, and play quiz-based games with students.[15] This platform enables instructors to create quizzes by adding multiple-choice (MCQ), true/false or short-answer questions. Audio and images can also be added to the questions. Once a question set is made, an instructor can play the game live in class or assign it as homework for students to play on their own.[15] The online quiz game Kahoot has become quite popular and has been shown to be beneficial.[8] Using Kahoot, instructors can create and host a live quiz game where the class is presented with a question only once. The student who answers the most questions correctly in the shortest time wins the game. Although similar to Kahoot, Gimkit has several features that distinguish it from Kahoot and other quiz games.

Gimkit offers more than just a quiz game; it has multiple game modes where players use strategy or apply skills to win the game. Players get "in-game credits" for each correct answer, which can be used to buy score-boosting "power-ups" and upgrades to get ahead of others. In Fishtopia mode, for example, the students answer questions to obtain fishing baits; the more questions are answered correctly, the more bait is received. The goal of the game is to use the bait to catch fish to sell and earn game money. Investing the game money in boosters such as speed to move around faster or a better fishing rod increases the chances of a player winning. Games can be played in groups or individually. The quiz questions are randomly repeated during game time, helping students learn and practice facts. Students can join the online live game from any device by entering the code provided by the host; no registration is needed. The live game displays a leaderboard to keep students motivated and engaged in the gameplay. Games can also be assigned as homework, which is suitable for online courses. Homework games, however, do not allow students to compete against each other or play in groups, nor do they provide a leaderboard.

Game-based learning was introduced in 2 dental hygiene courses at the University of Alberta in Edmonton, Canada. One course is offered in person while the other is an asynchronous online course. In-class live quiz games and games as homework assignments were found to positively impact students' learning experience, satisfaction, and knowledge acquisition in a previous study.[16,17] In this study, the authors explored students' gaming experiences with, choices, perceptions of, and sources of motivation for game-based learning. The research questions were as follows:

1. How does the game-based learning experience vary between online and in-person classes?
2. How do students' choices of game mode vary between online and in-person classes?
    a. What game mode is most preferred by students for live quiz games?
    b. What game mode is most preferred by students for homework assignments?
3. How does students' motivation for playing the game vary between online and in-person classes?
    a. Are students driven by intrinsic or extrinsic motivation to participate in a live quiz game?
    b. Are students driven by intrinsic or extrinsic motivation to participate in a game-based homework assignment?

METHODS

Implementing game-based learning using Gimkit

Two types of game-based learning were implemented in 2 different dental hygiene courses.

Live quiz games in the Oral Biology II (OBIOL 302) course

OBIOL 302 was offered in person to the third-year dental hygiene students, focusing on the unique physiology, biochemistry, and nutrition of oral structures. Some key topics covered in this course included functions of the periodontal tissues, the temporomandibular joint, mastication, special reflexes involving cranial nerves, receptors of the stomatognathic system, and salivary glands. In fall 2023, 43 students were enrolled in this course. Both team-based and free-for-all game modes were played, and the games had varying difficulty levels. The 3.0 credit course ran for around 15 weeks with three 50-minute weekly lectures. A total of 9 games were played in this course; 10 to 12 minutes were allocated for the gameplay within the scheduled lecture time. Students were given a 2-minute practice game time (with rudimentary math questions) to become familiarized with the game controls. The game contained practice questions from lectures previously covered in class.

Game-based homework assignments in the Oral Biology I (OBIOL 202) course

OBIOL 202 was offered as an asynchronous online course to 47 second-year dental hygiene students in winter 2024. Over the winter semester, the 2.0 credit course focused on embryological development and specific histology of the oral cavity. The asynchronous course ran for 15 weeks with 2 weekly vodcasts posted on the learning management system (LMS). Seven games were posted in the LMS. Each game was posted in 2 different game modes, and the modes varied throughout the course. Students could choose which mode to play for a particular set of questions.

Gimkit currently has 25 different game modes. Some modes are designed to be played in teams only, and some are to be played as free-for-all only, where everyone competes against each other. Other game modes have the option to select teams or free-for-all. Based on technical skill requirements, the Gimkit modes were further divided into 1) easy, 2) medium, and 3) hard. Game modes from easy categories require no computing or gaming skills from players. Players can proceed through the game simply by answering questions using a tap or mouse-click. Medium category games require players to use a mouse and keyboard to move the characters around the game map. Games from the hard category need players to use multiple keys to make the characters skillfully run, jump or climb. The distribution of different types of game modes in OBIOL 302 and OBIOL 202 courses is outlined in Figure 1.

Study design

A descriptive study design was applied in this research. A descriptive study systematically describes a population, situation or phenomenon without identifying the underlying cause.[18,19] This study aimed to explore and describe students' experiences with, perspectives on, and motivations for game-based learning. The University of Alberta Research Ethics Board (REB 2) reviewed and approved this study (ID: Pro00124923).

Study participants

Students from the second and third years of the dental hygiene program participated in this study. The second-year students were enrolled in the OBIOL 202 course and participated in the game-based homework assignments in the winter 2024 semester. The third-year students were enrolled in the OBIOL 302 course in fall 2023 and participated in the live quiz games.

Data collection and analysis

Students were invited to participate in the voluntary online survey to collect their gaming experiences, choice of game mode, motivation source, and perceived benefits of playing the live quiz game and the game-based homework assignments. The gaming experience largely depends on the device used to play the game,[20] so the survey included questions on the device used by the students to play the games. Descriptive statistics were applied to analyze the survey data using Microsoft Excel. Students' written comments from the open-ended questions were also explored to better understand their perceptions of game-based learning experiences.

RESULTS

Participation in the game was optional for both the in-person OBIOL 302 and the online OBIOL 202 courses. Ninety-four percent (94%) of the online class (n = 44) participated in the game throughout the course. For the live quiz games in the in-person class, students who were present on those days were invited to play. As students had options to join the game anonymously and share devices among themselves, their participation in the game was not tracked. Thirty-five percent (35%) of the OBIOL 302 class responded to the survey (n = 15). Thirty percent (30%) of the online class who participated in game-based homework responded to the voluntary survey (n = 14). To ensure positive selection during the survey, the very first survey question asked if a participant played Gimkit in the course or not. "Yes" to this first question allowed a participant to proceed through the survey and submit it.

Students' experience of the game-based learning

When asked about the type of device on which they played Gimkit, most respondents (93% of the in-person class; 100% of the online class) mentioned using computers and laptops to play the game. A small percentage of participants reported using smartphones, tablets, and iPads (Figure 2A). Similarly, 93% of the online student participants

Figure 1. Distribution of different game modes in the 2 courses

Game type	**Course:** OBIOL 302 **Location:** In-person **Game-based learning:** Live quiz games	**Course:** OBIOL 202 **Location:** Online asynchronous **Game-based learning:** Homework assignments
Individual (Free-for-all) 	**Super Rich Mode** **Difficulty level:** Easy ★☆☆ **Game Goal:** All players try to earn as much game money as they can before the time runs out. **Description of activity:** Players are presented with questions. They are awarded game money for each correct answer. Players can invest game money to create disturbance for opponent player, or protect themselves from opponents disturbance. Disturbance include, bluring or freezing opponents screen etc.	**Super Rich Mode (Cash Tycoon)** **Difficulty level:** Easy ★☆☆ **Game (Assignment) Goal:** Earn a certain amount of game money set by the instructor. **Description of activity:** Players are presented with questions. They are awarded game money for each correct answer. Players can invest game money to buy boosters to get more money per questions.
	Fishtopia **Difficulty level:** Medium ★★☆ **Game Goal:** All players try to earn as much game money as they can by selling fish before the time runs out. **Description of activity:** Players must answer questions to get fishing baits, used for catching fish. Fishes are sold to get game money. Players can invest game money to buy improved rods and speed-ups to move faster.	**Fishtopia** **Difficulty level:** Medium ★★☆ **Game (Assignment) Goal:** Earn a certain amount of game money, buy selling fish, set by the instructor. **Description of activity:** Player must answer questions to get fishing baits, used for catching fish. Fishes are sold to get game money. Player can invest game money to buy improved rods and speed-ups to move faster.
	Don't look down **Difficulty level:** Hard ★★★ **Game Goal:** All players try to jump and climb to the top before the time runs out. **Description of activity:** Players must answer questions to get energy. Energy is used to move around and jump.	**Don't look down** **Difficulty level:** Hard ★★★ **Game (Assignment) Goal:** Player must jump and climb to a certain level set by the instructor. **Description of activity:** Player must answer questions to get energy. Energy is used to move around and jump.
Team-based 	**Teams** **Difficulty level:** Easy ★☆☆ **Game Goal:** Players are divided into teams. All teams to earn as much game money as they can before the time runs out. **Description of activity:** Players are presented with questions. They are awarded game money for each correct answer. Players can invest game money to create disturbance for opponent team, or protect themselves from opponents disturbance. Disturbance include, bluring or freezing opponents screen etc.	
	Capture the flag **Difficulty level:** Hard ★★★ **Game Goal:** Players are devided into two teams. As part of a team, players try to capture the flag of the other team without getting tagged. **Description of activity:** Players must answer questions to get energy. Energy is used run around. Players can invest in buying boosters to run faster or to become invisible.	

and 80% of the in-person participants reported using keyboards rather than touch screens (Figure 2B). Only 20% of in-person and 14% of online class participants reported finding the game controls challenging (Figure 2C). When asked to elaborate on the type of difficulty faced during gameplay, several students mentioned:

> *"sometimes the touchscreen would glitch when trying to move"* [in-person class]
>
> *"pictures are unclear sometimes" [online class]*
>
> *"I didn't find any difficulties but I just didn't like that my data never saved so when I went back in, I had to restart from the beginning"* [online class]

No relation was found between the device used and reports of game controls being challenging. For the in-person class, 5-minute preparatory games were played, which was found to be helpful by 40% of the survey participants (Figure 2D).

All (100%) of the survey participants from the online and in-person groups strongly agreed that their knowledge was improved by playing the game (Figure 2E). All participants either agreed or strongly agreed that the repeated questions in the game helped them memorize facts. Most participants from the online and in-person groups indicated they enjoyed the playful activity (Figure 2E, Table 1).

Several student comments showed appreciation for the balance between gameplay and learning:

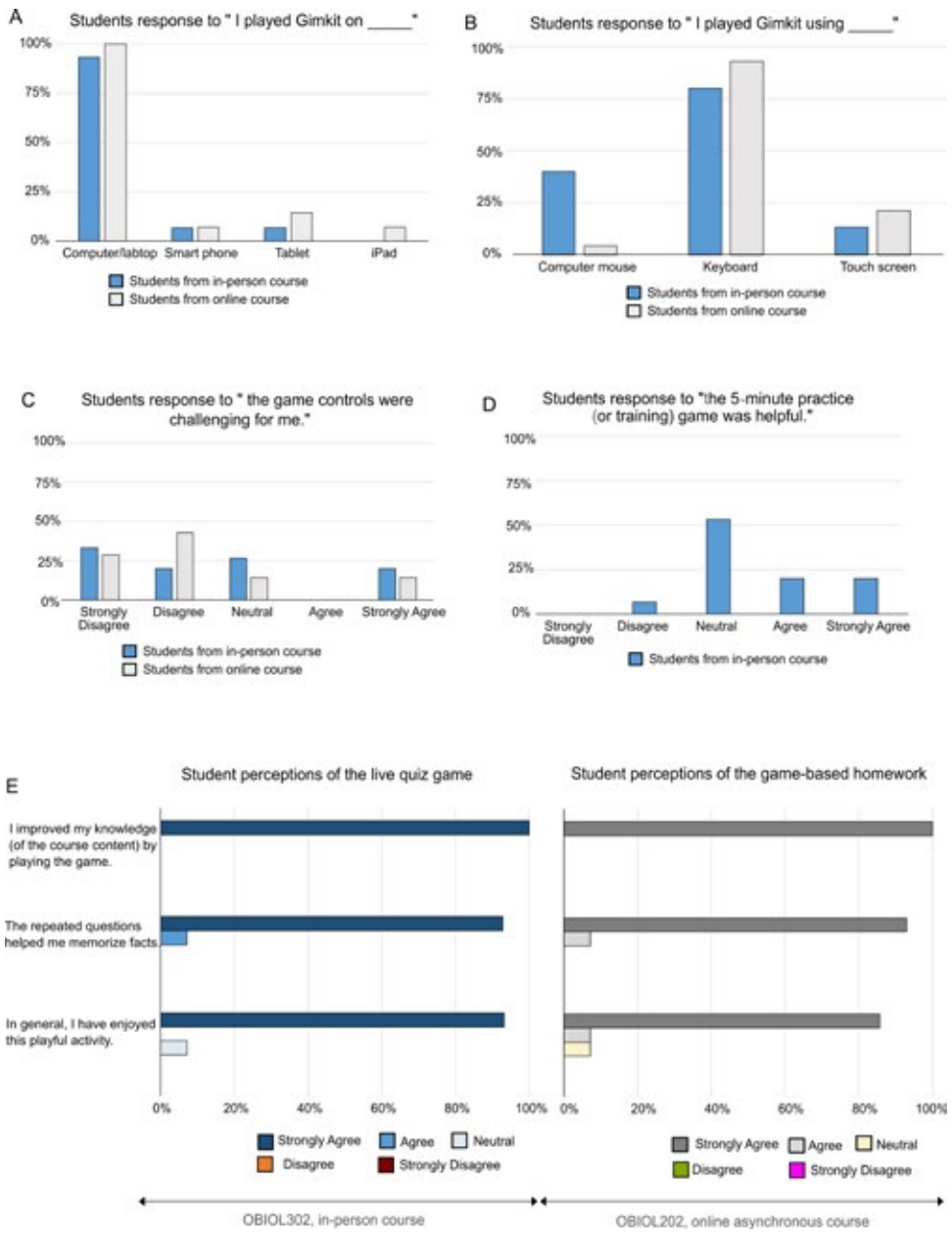
> *"It is a good balance of the questions and still have a good interactive gameplay."* [in-person class]

> *"I like that there is a game part of skill in jumping and adventure but also that you have to answer questions to be able to jump."* [in-person class]

Students' choice of game modes

When asked about the game modes in Gimkit, most of the survey participants from the in-person OBIOL 302 course indicated they liked free-for-all games the most. The top choices of specific game modes were Fishtopia and Don't Look Down (Figure 1, Figure 3). Students from the online asynchronous course had no option to play in teams or compete against each other. As game-based homework assignments, their favourite game modes were Fishtopia and Super Rich Mode (Cash Tycoon) (Figure 1, Figure 3). Descriptive student comments from open-ended questions shed some light on why they chose specific game modes (Figure 3).

Figure 2. Students' experience of the game-based learning



Nature of motivation

A higher percentage (93%) of the students who played live quiz games in class were extrinsically motivated, playing the game from the expectation that it would help them learn. Fifty-three percent (53%) of the students were intrinsically motivated to play the live quiz game (Figure 4A). When asked about the nature of their intrinsic motivation, most participants (53%) identified "competition," followed by "challenge imposed by the game" as driving them towards Gimkit live quiz games (Figure 4B). Open-ended student comments showed that some students became quite involved in the gameplay, motivated by in-class competition and live leaderboards. Others appreciate that winning the game combined strategy, skill, and knowledge.

> *"I got pretty sweaty while playing some of the games like Don't look down, or even if [sic] the fishing game, but that's because they both activated an adrenaline rush in me, and I still had lots of fun!"* [in-person class]

> *"I like that you don't have to be good at the game itself to be able to be successful. For example, you have to be good at the jumping on the jumping game to win"* [in-person class]

Students who played Gimkit as homework assignments were also largely motivated extrinsically and played the game to learn course content. Of this online student group, 35.7% were attracted by the intrinsic nature of the game (Figure 4C). For online students, the challenge imposed by the homework games was the most attractive feature (Figure 4D). Some relevant student comments are as follows:

> *"I really liked having access to practice questions in a more interactive way"* [online class]

> *"Overall I have had a really good experience and it is a fun easy way to study when you are low on energy or feeling unmotivated."* [online class]

DISCUSSION

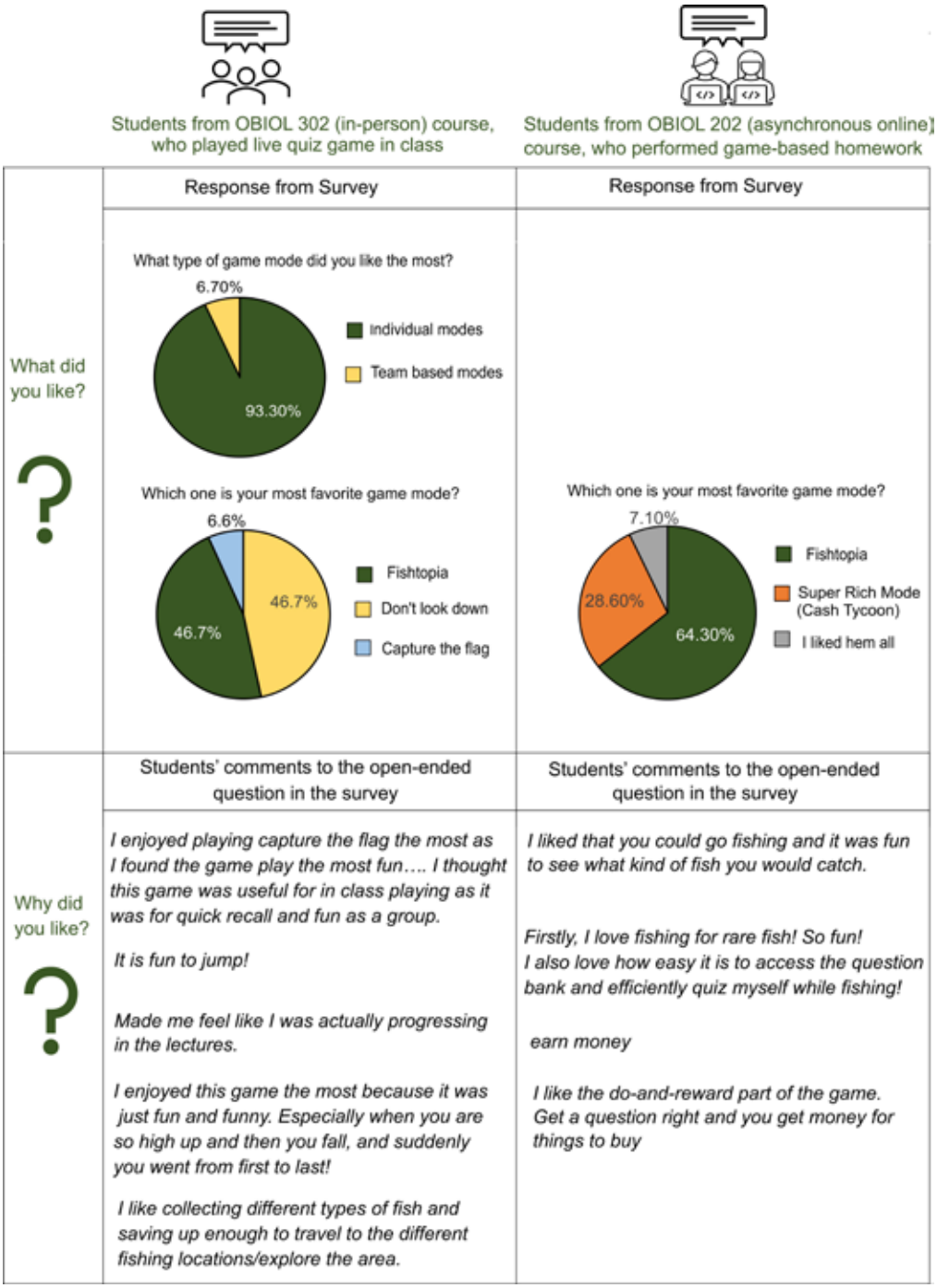
Gimkit is a WebGL platform for creating and hosting game-based learning. Using Gimkit, live quiz games for an in-person course and game-based homework assignments for an asynchronous online course were offered. Gaming experience, choice of game modes, and motivation for playing the games were explored and compared between the 2 cohorts of students.

Table 1. Representative student comments on the open-ended questions of the survey

Course	Survey question: Please comment on your experience.
OBIOL 302 (in person)	• *It really helps me to learn and memorize topics!* • *... it keeps me entertained and engaged in the contents.* • *I felt that it was an engaging activity that help solidified my learning.* • *I had fun using Gimkit, I found that it allowed me to not only understand what areas I had to restudy or focus on but it also really helped me with my studying and memorizing and further understanding the concepts! Definitely prepared me for the exam, and enjoy class!* • *Overall, this is a very helpful tool when learning and studying the lecture material. I really enjoy doing them and it helps that the questions repeat so that you can solidify your understanding.*
OBIOL 202 (asynchronous online)	• *Overall I have had a really good experience and it is a fun easy way to study when you are low on energy or feeling unmotivated.* • *It was good to go through the games after reviewing the section improved my memory.* • *I really liked having access to practice questions in a more interactive way.* • *Was great* • *Having the content in another form other than the lecture slides or my notes was incredibly helpful. It allowed me to review and gain a better grasp of the content while enjoying doing it! It absolutely helped me with memorizing the content as I would play the games a number of times.*
Course	**Survey question: Suggestion for improvement**
OBIOL 302 (in person)	• *Keep doing them for classes* • *Overall, I think there are no significant improvements that need to be made.* • *None, honestly Gimkit is super helpful and has helped significantly with my learning, no issues at all!* • *More questions as it is easy to go through all of them quickly*
OBIOL 202 (asynchronous online)	• *Add more questions to the question bank.* • *More questions for each topic* • *Being able to go back to questions* • *My only suggestion is more questions!*

Gimkit has 25 game modes to foster free-for-all competition (where everyone competes against everyone), team-based competitions, and collaboration. Two team-based games and 3 free-for-all games were chosen from the Gimkit game collection to play live in class. For the online asynchronous students, 3 individually playable games that were either the same or comparable to the free-for-all games played in the in-person class were carefully selected. Based on the requirements of computer/keyboard skills, the games were assigned 3 levels of difficulty: easy, medium or hard. Most students from both online and in-person groups disagreed with the statement that "Game controls were challenging for them." Although most students stayed neutral, some students from the in-person group found the 5-minute practice game helpful before the actual game. For Generation Z, who typically spend around 3 to 7 hours a week on gaming, this result is not surprising.[21]

Figure 3. Students' choice of game modes from Gimkit. Representative student responses to the open-ended questions are also presented.



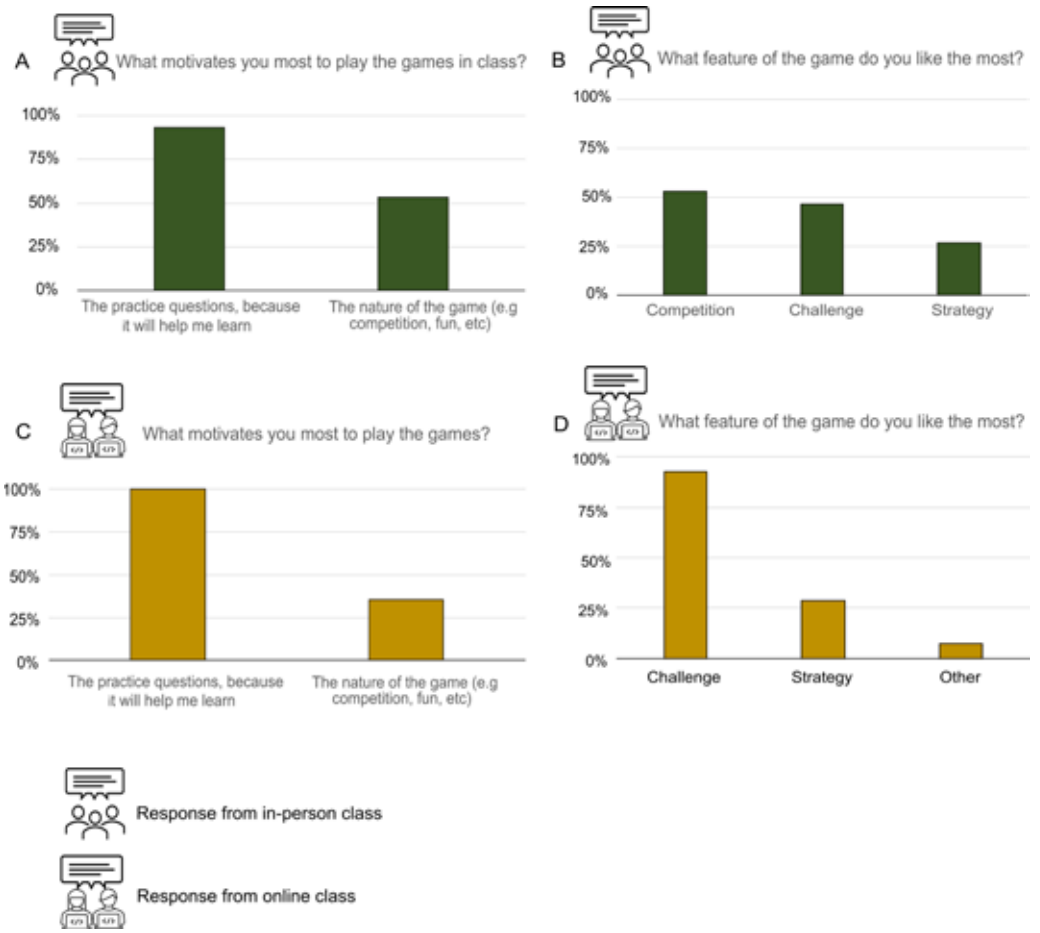
It can be challenging to strike a balance between enjoyment and education when developing educational games.[22,23] Many question the possibility of achieving 2 objectives—fun and education—at the same time; that is, the more fun a game is, the weaker its educational value must be.[22] Gimkit is not meant to provide profound gaming experiences. Alignment with the learning objectives is crucial to ensure that learning is not compromised. However, the large range and type of game modes allow instructors to choose a game suitable for any age and learning outcome.

The present study showed that most students were extrinsically motivated to play Gimkit, with no major differences between whether the game was played with others in the classroom or alone as a homework assignment. Although students overwhelmingly agreed they enjoyed the games, their motivation was tied to practice questions that they perceived as helpful for exam preparation. Live games in Gimkit have leaderboards, one of the game elements that create intrinsic motivation for players.[24] However, the expectation from a successful educational game is that it will help users find their own reasons for engaging with the game.[14] As apparent from many student comments, Gimkit successfully helped them internalize the extrinsic motivations (intention to perform better in the exam), enhancing self-determinedness.[13] Students highly appreciated the practice questions and also enjoyed the gameful activity. For many online asynchronous students, the gameplay itself was the source of motivation (Table 1).

Although the leaderboard is a powerful motivational tool, it can cause stress and discouragement in students who rank low on the leaderboard.[25,26] Unlike Kahoot and many other quiz-based games, Gimkit ranks players by performance in the game, not by knowledge accuracy. This feature of Gimkit enables students to enjoy the live game in class without fearing looking "bad" in front of their classmates.

Creating educational games can take considerable amounts of time, resources, and creativity on the part of the instructor. Using existing platforms, such as Gimkit, can streamline the process. One of the benefits of gamified and game-based learning using Gimkit is that it has a built-in, immediate feedback mechanism. When a student answers correctly, they can advance in the game. When students choose an incorrect answer, the correct answer is presented to them, which can motivate students to learn the material to progress through the game. These types of educational games can also be of benefit from a teaching perspective. Student performance can provide insight for the instructor on which concepts require further

Figure 4. Source and nature of motivation for playing Gimkit. Live quiz games were introduced in OBIOL 302, which ran in person (A, B). Game-based homework assignments were implemented in OBIOL 202, an online asynchronous course (C, D).



clarification or elaboration, acting as formative feedback on the efficacy of their teaching. Analytics gleaned from student engagement with the games can help instructors identify the most effective teaching strategies. Besides having game modes requiring different levels of game skills, instructors can design games with varying difficulty levels in the subject matter. This approach can help instructors achieve the expected learning outcomes while students learn with fun experiences.

The findings of this study are based on perception data and are only from dental hygiene students, which may limit the applicability of the results. No demographic data were collected. Students' performance in the game was not compared with their academic performance. In addition, no assessment of students' prior gaming skills was made, which may have caused some students to find the game controls challenging. Further studies are needed to measure student engagement and its correlation with students' gender, age, and academic performance.

CONCLUSION

Gimkit is a platform for creating game-based learning experiences for students. The incorporation of game-based learning in 2 dental hygiene courses was well received by the students. Most students were extrinsically motivated and participated in the game hoping that it would help them learn.

CONFLICTS OF INTEREST

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

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