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

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ABSTRACT

Background: Game-based learning aims to promote student engagement and 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 two dental hygiene courses; one was offered in-person, and the other was asynchronous online. This study aimed to explore students' perception of game-based learning experiences, their choice of game modes, and the source of motivation. **Methods:** Students from the 2nd and 3rd years of the Dental Hygiene (DH) program were invited to participate in a voluntary online survey to collect their perceptions on the gaming experiences, choice of game mode, and motivation toward playing the live quiz game and the game-based homework assignments. 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 (n=14). All participants from the online and in-person groups strongly agreed to have 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 promote motivation and self-determination in dental hygiene students.

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] The current students in health professions schools are predominantly from Generation Z (born between 1995 and 2009), with a very different attitude and behaviour than the previous generation. This new generation of students is technology-native, fast, and result-oriented.[3] To attract, engage, and motivate this new generation of 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 three ways: (i) Gamification, which refers to incorporating game elements, like leaderboards and badges, to create a gameful experience. Gamification can be attained by adding simple activities like a progress bar or virtual rewards in the learning management system.[7] (ii) Game-based learning concerns applying 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] (ii) 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 behavior through user motivation.[11] The impact of gamification on user motivation can be explained by the self-determination theory (SDT).[12] Humans are driven by two 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 like rewards and leaderboards are proposed to play roles in improving 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 foster long-term motivation and engagement throughout the course would be to design games where students find their reasons for engaging with the game.[14]

Gimkit (www.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 question. 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. Similar to Kahoot, Gimkit is also a quiz-based game. However, Gimkit has several distinguishing features 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 get the 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 like 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, play in groups, or provide a leaderboard.

We have introduced game-based learning in two dental hygiene courses; one is offered in-person, and the other as asynchronous online. In-class live quiz games and games as homework assignments were found to positively impact students' learning

experience, satisfaction, and knowledge acquisition in our previous study.[16,17] In this study, we aim to explore students' gaming experiences, choices, perceptions, and sources of motivation toward game-based learning. Our specific research questions include the following:

1. How does the game-based learning experience vary between online and in-person classes?
2. How do students' choice 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 do students' motivation for playing the game vary between online and in-person classes?
    a) Are students driven by the 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

We implemented two types of game-based learning in two different Dental Hygiene (DH) courses.

- *Live quiz games were implemented in the Oral Biology II (OBIOL 302) course:*

OBIOL 302 was offered in-person to the 3rd-year DH 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 the Fall of 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. 10-12 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 were implemented in the Oral Biology I (OBIOL 202) course:*

OBIOL 202 was offered as an asynchronous online course to 47 2nd year DH students in the winter of 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 two weekly vodcasts posted on the learning management system (LMS). Seven games were posted in the LMS. Each game was posted in two

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 the requirements of technical skills, we further divided the Gimkit modes into (i) Easy, (ii) Medium, and (iii) 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' games require players to use a mouse and keyboards 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] In this study, we aimed to explore and describe students' experiences, perspectives, and motivations toward game-based learning. The University of XXX Research Ethics Board (REB 2) reviewed and approved this study (ID: Pro00124923).

Study participants

Students from the 2nd and 3rd years of the DH program were the participants of this study. The 2nd year DH students were enrolled in the OBIOL 202 course and participated in the game-based homework assignments in the Winter 2024 semester. The 3rd year DH 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, 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 students' 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 question on the survey 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 inquired about the type of device used to play Gimkit on, most respondents (93% of the in-person class and 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 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 the report of game controls being challenging. For the in-person class, who played live quiz games, 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 online and in-person groups indicated they enjoyed the playful activity (Figure 2E, Table 1).

Several student comments showed appreciation for the games being a good 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 inquired about the game modes from Gimkit, most of the student participants from the in-person OBIOL 302 course who played Gimkit live in the class 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).

Nature of motivation

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

> *"I got pretty sweaty while playing some of the games like don't look down, or even if 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. 35.7% of this online student group were driven to play the game, attracted by the intrinsic nature of the game (Figure 4C). For online students, the 'challenge' imposed by the game was the most attractive feature of the homework games (Figure 4D). Some relevant student comments include:

"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 WebGL platform for creating and hosting game-based learning. Using Gimkit, we implemented two types of game-based learning: live quiz games for an in-person course and game-based homework assignments for an asynchronous online

course. Gaming experience, choice of game modes, and motivation for playing the games were explored and compared between the two cohorts of students.

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 three free-for-all games were chosen from the Gimkit game collection to play live in class. For online asynchronous students, three individually playable games that are 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, we assigned the games three 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 was helpful before the actual game. For Generation Y, who typically spend around 3-7 hours a week on gaming, this result is not surprising.[21]

Balancing between enjoyment and educational value can be challenging in developing educational games.[22,23] Many oppose the possibility of achieving two objectives, 'fun' and 'education' at the same time; the more 'fun' a game is, the weaker its educational value.[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.

Our 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 to enjoy the games, their motivation was tied to practice questions that they perceived 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 internalize the extrinsic motivations (intention to perform better in the exam), causing self-determinedness in students.[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, like 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, regarding which concepts require further 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. We acknowledge that this may limit the applicability of the findings. No demographic data was collected. Students' performance in the game was not compared with their academic performances. Besides, no assessment of students' prior gaming skills was made, which may cause some students to find 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 potential platform for creating game-based learning experiences for students. The students well-received the incorporation of game-based learning in two dental hygiene courses. Most students were extrinsically motivated and participated in the game hoping that it would help them learn.

PRACTICE IMPLICATIONS:

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

Conflict of interest: The authors of this study declared no conflict of interest.

Ethics Approval: This study has been approved by the Research Ethics Board of the University of XXX (ID: Pro00124923).

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FIGURES AND TABLES

Figure 1. Distribution of different game modes over the two 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.	

Figure 2. Students' experience of the game-based learning. Gimkit was implemented in two Dental Hygiene (DH) courses. Students from the in-person course (OBIOL 302) played live games in class. On the other hand, students from the online asynchronous course (OBIOL 202) played gimkit as homework assignments. Students were invited to participate in a survey, asking about what devices they used to play Gimkit. 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).

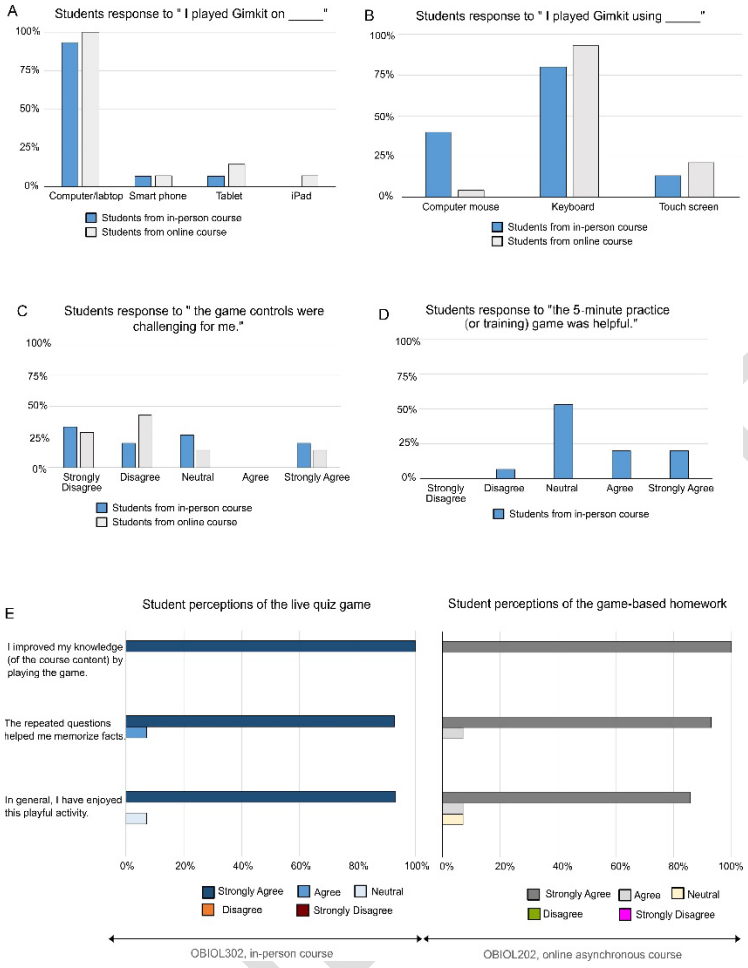

Figure 3. Students' choice of game modes from Gimkit. Students from online and in-person classes were invited to participate in a survey. Thirty-five percent (35%) of the in-person class (n=15) and thirty percent (30%) of the online class (n=14) responded to the voluntary survey. Representative students' responses to the open-ended questions are also presented.

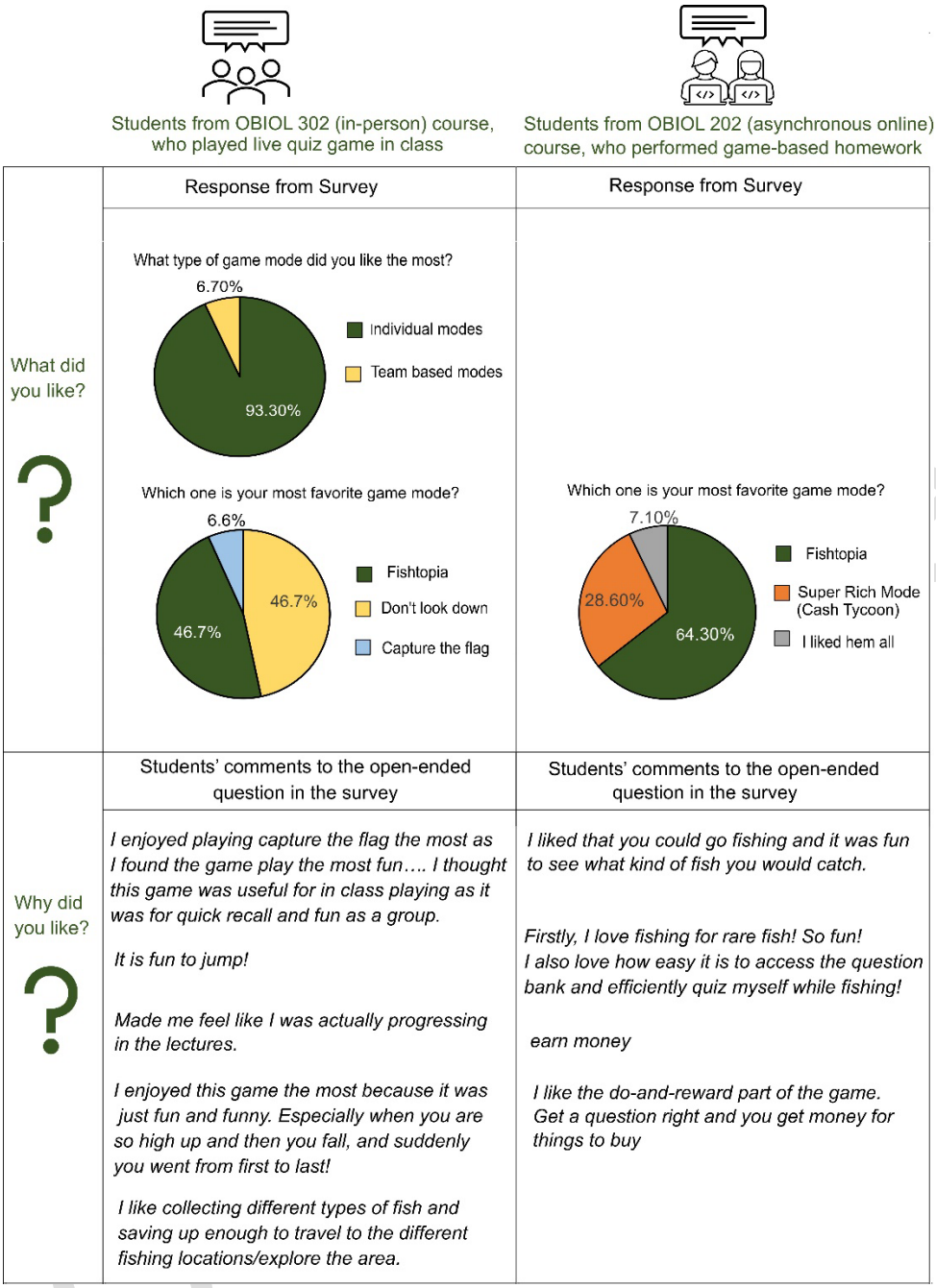

Figure 4. Source and nature of motivation for playing Gimkit. Gimkit was implemented in two Dental Hygiene (DH) courses. Live quiz games were introduced in the Oral Biology II (OBIOL 302) course, which ran in-person (A, B). Game-based homework assignments

were implemented in Oral Biology I (OBIOL 202), an online asynchronous course (C, D). Students were asked to participate in a voluntary survey. 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).

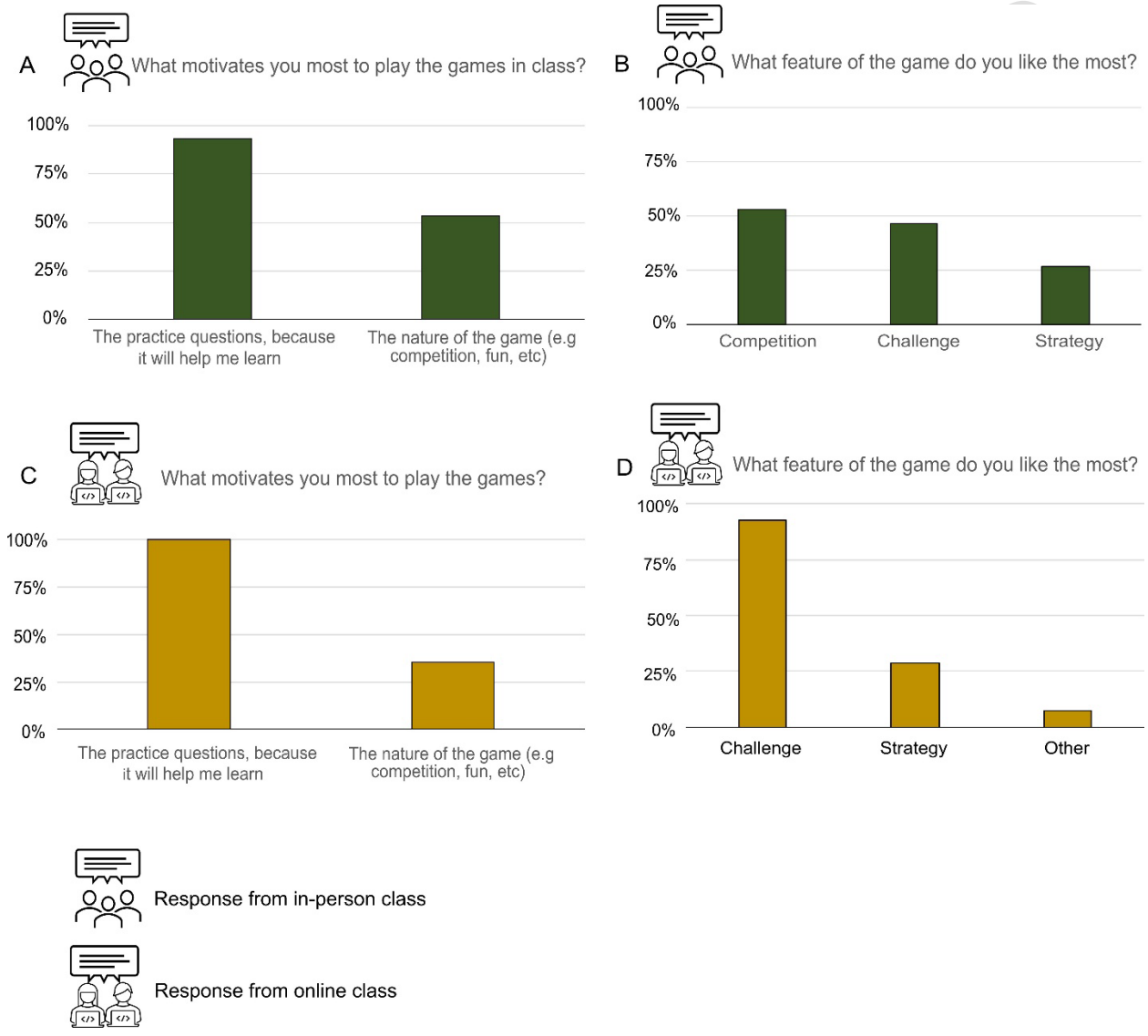

Table 1. Representative student comments on the open-ended questions of the survey.

Question on survey: Please comment on your experience.	
Student comments from OBIOL 302 (in person) course who played Gimkit as live quiz game.	• *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.*
Student comments from OBIOL 202 (asynchronous online) course who played Gimkit as homework assignments.	• *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.*
Question on survey: Suggestion for improvement	
Student comments from OBIOL 302 (in person) course who played Gimkit as live quiz game.	• *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 sinificantly with my learning, no issues at all!* • *More questions as it is easy to go through all of them quickly*
Student comments from OBIOL 202 (asynchronous online) course who played Gimkit as homework assignments.	• *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!*