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Original Article

Effect of bingo puzzle game in understanding pathology

R. Haripriya

Department of Pathology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India

Abstract

Aim: The aim of this study is to determine the effect of bingo puzzle game in understanding pathology.

Introduction: Students are introduced to newer terms and concepts in pathology, and it has been observed that students often find it difficult to remember and recall various concepts and mechanisms. Hence, reinforcement of key concepts is indispensable to increase understanding. Bingo puzzle game stimulates the mind, increase the vocabulary, and help to develop a healthy skepticism.

Materials and Methods: The study sample size was 150 students. (1) Group 1: 75 students not exposed to a bingo puzzle game. (2) Group 2: 75 students exposed to a bingo puzzle game. Both the groups were asked to take up a written test, and the results were statistically analyzed with unpaired *t*-test, compared, and represented graphically.

Results: The unpaired *t*-test shows the value of $P < 0.05$, and this study shows that there is a significant increase in the marks obtained by the students who learned by playing bingo puzzle game. Thus, this type of active learning methods helps students to understand pathology in an effective way.

Conclusion: In conclusion, the game based activity is very helpful in understanding the pathology concepts. Especially, to list out the various causes and examples for a single pathology, Bingo Puzzle game is useful and an innovative methodology in teaching Pathology.

Keywords: Active learning, bingo puzzle game, group, pathology, understanding

Address for correspondence: Dr. R. Haripriya, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, 162, Poonamallee High Road, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India.
E-mail: generalpath2015@gmail.com

INTRODUCTION

Active learning methods have their own advantages which preliminarily include fostering the development of critical thinking, communication, cooperative learning skills, and attitudes and values; promoting concept formation; providing an avenue for locating misconceptions; and increasing motivation.[1] Numerous forms of interactive games[2-7] and puzzles[1,8-10] have been suggested by researchers as active learning methods which help in creating an interactive learning experience by transforming inactive learning material into interesting learning episodes where the learners participate as active players.

Students are introduced to newer terms and concepts in pathology, and it has been observed that students often find it difficult to remember and recall various concepts and mechanisms. Hence, reinforcement of key concepts is indispensable to increase the understanding, learning, and retention of all the concepts.

Bingo puzzle game stimulates the mind, increase the vocabulary, and help to develop healthy skepticism.[1]

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Therefore, instead of passive memorization of material, bingo puzzle game can be beneficial as a self-learning tool to promote active learning and to develop a practical application and critical thinking.

A developing body of research has suggested that incorporating active learning methods help in better understanding and learning.[11,12] The active learning forms which include games and puzzle are helpful to understand, review, summarize, practice, find out gaps in knowledge, and develop new relationships among concepts.[13] Games are considered valuable for the accession and application of physiological feature, affective, and body process information and skills.[14]

Gaming provides the novel opportunity for the learners to scrutinize information and to study the outcome of their choices, leading to trial and error exploratory learning.

As quickly evolving technological applications, games, and simulations are already widely integrated in the traditional educational process. They are established vastly in the educational field, with a subsisting body of work analyzing the relation between games and education.[15] Games and simulations show mixed effects across some sectors, such as student performance and learning motivation.

Various active learning methods, including bingo puzzle, have been incorporated into these courses in an attempt to increase the understanding, learning, and retention. Bingo puzzle was introduced as a quick and effective way to reinforce critical concepts and proper understanding and differences of two or more similar concepts with the hope that the students would be better able to recall essential concepts. In addition, the puzzles were intended to be engaging while providing an opportunity for discussion and reasonable distinguishing.

Learning theories generally emphasize the need for immediate feedback and student involvement for ideal learning situations.[16] Games provide a responsive environment where learners immediately analyze how they are doing.[17] Students admit that they wait to study for the course till the last min before examinations because most of their time is spent on "high-stake" courses.

The "test-to-test" culture does not have a positive impact on class attendance, with students frequently absenting themselves for classes, especially before and after examinations in other courses. Although most students pass the course, students do not seem to retain the material for application in the upper-level courses.[18] The bingo game concept seemed like a realistic motivational tool for students. Given the increased emphasis placed on the assessment and evaluation of student learning.

It also seemed to be a good method for expanding the types of learning activities offered to students.[19-22]

The bingo activities were chosen to encourage students to review course material at least every 2 weeks, to make them understand the concepts better, to motivate students to perform better on the required graded activities to appeal to students with different learning styles (posters, computer animations, three-dimensional objects, poems, videos, and crossword puzzles), and to encourage close attention to required readings and lecture material.

MATERIALS AND METHODS

Sample size was 150 students.

- Group 1: 75 students not exposed to a bingo puzzle game
- Group 2: 75 students exposed to a bingo puzzle game.

Inclusion criteria

Random group of students who are neither exposed nor have learned the topic before were included in the study.

Exclusion criteria

Students those who have knowledge about the selected topic or those who have previously learned the topic before were excluded from the study. Students those who do not have pathology as their main subject were also excluded from the study.

The topic used for the bingo puzzle game was adaptations of the cell. The cell undergoes various types of adaptations which include reversible changes in the size, number, phenotype, metabolic activity, or functions of the cell. The cellular adaptations include hyperplasia, hypertrophy, hypoplasia, aplastic, and metaplasia. The students were taught about various cellular adaptations that our body undergoes and how they are classified. Now, the group of 150 students was split into two groups, each group containing 75 students. Group 1 which includes 75 students was asked to take up a test for 5 marks based on the lecture. Group 2 which includes the other set of 75 students was asked to take up the bingo puzzle game. The bingo puzzle game includes boxes in which the various physiological and pathological changes of cellular adaptation were given. The students in Group 2 who are taking up the bingo puzzle game were asked to use different colors to indicate different types of cellular adaptations. After the students completed the bingo puzzle game, they were asked to take up a small

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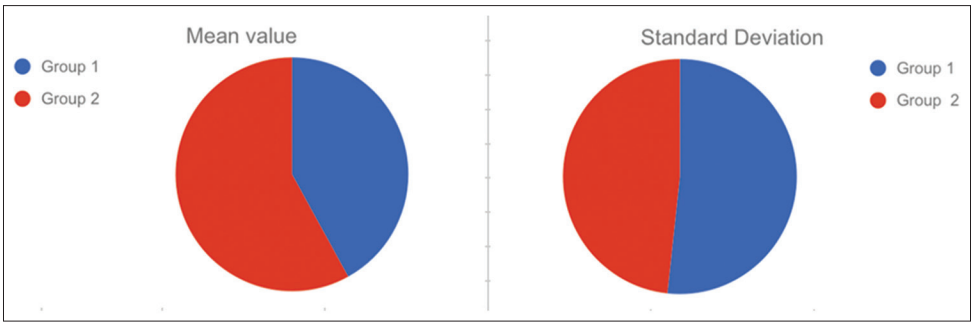

Figure 1: Mean and standard deviation

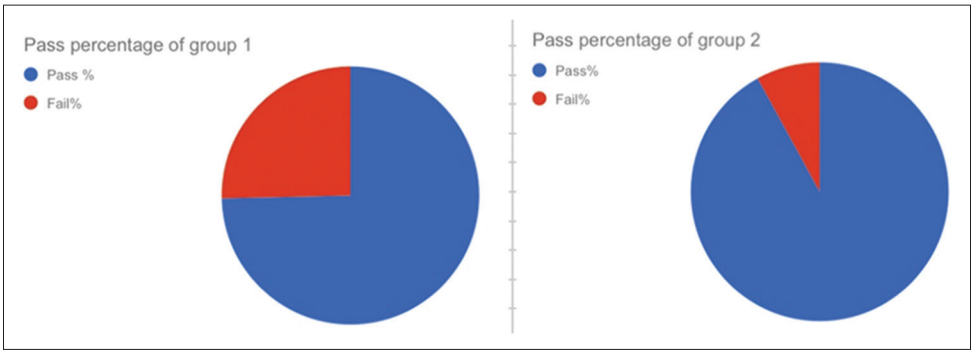

Figure 2: Pass percentage

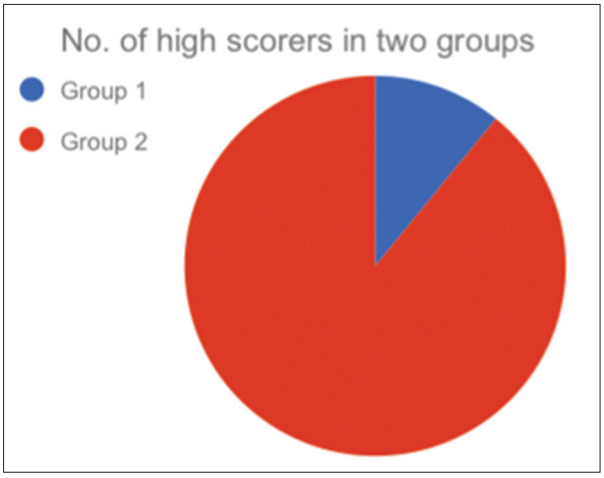

Figure 3: Number of highest mark scorer's in each group

test on the same topic for five marks. The results of both the groups were compared.

RESULTS

The mean and the standard deviation of the marks obtained by the Group 1 and Group 2 were calculated and showed in the Figure 1 and Table 1. The mean value of Group 1 which was not exposed to bingo puzzle game was found to be 2.64 and when it was calculated for Group 2 which was not exposed to a bingo puzzle game, the mean value was found to be 3.65. The standard deviation of Group 1 was found to be 0.91, and for Group 2, it was found to be 0.85. The Figure 2 and Table 2 showed the Pass amd Fail percentage of the Group 1 and Group 2. The pass percentage of Group 1 was found to be 74.6%, and the fail percentage was 25.3%.

The pass percentage of Group 2 was 92% which had a significant increase when compared with Group 1, and the fail percentage was 8% which was much lower than that of Group 1. The number of highest mark scorers before and after the exposure of the game based learning in Group 1 and Group 2 is showed in the Figure 3. The number of the highest scorers was more in Group 2 than in Group 1. The unpaired *t*-test shows the value of $P < 0.05$.

DISCUSSION

Faced with high-stakes examinations, medical students study strategically. They look for ways of consolidating their knowledge of the core curriculum and prioritize study materials and strategies that relate directly to their upcoming exams.[23] The constructivist theory of learning suggests that the most effective learning occurs when knowledge is constructed or reconstructed by individual learners rather than being transmitted directly from instructors.[24] Student engagement may be the best achieved during the knowledge construction process, in which students are actively integrating new information into the old information.

Rooted in the constructivist theory of learning, the flipped classroom approach has been theorized to be effective in

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Table 1: Mean and standard deviation

Groups	Mean	SD
Group 1	2.64	0.91
Group 2	3.65	0.85

SD: Standard deviation

Table 2: Pass percentage

Groups	Pass percentage	Fail percentage
Group 1	74.6	25.3
Group 2	92	8

enhancing the student engagement by actively involving students in their own knowledge construction processes.[25]

Active meaningful learning is supposed to play a central role in medical education, especially during small-group work (SGW) sessions and interactive lectures. This type of learning is driven by continuing dialog among students, and between students and tutors, creating a constructive educational environment that enhances conceptual understanding based on the constructivist theory of learning.[26] As student-centered learning is moving toward participatory education,[27,28] endowing students with the role of cocreator of their education, it is a prerequisite that students' input in the small group dialog increases. In earlier studies, students have indicated that group interaction and active student participation, as well as the opportunity to ask questions, are essential components of effective SGW.[29]

There are three factors which were related to pathological use of game with the great importance: the use of games to escape the routine way of learning, the use of games as a social outlet, and positive attitudes toward the steady accumulation of knowledge and concepts. Game-based learning was statistically more effective than the interactive lecture in knowledge achievement and satisfaction scores. The quality of such game-based learning is crucial to the progress of a student with respect to all aspects of learning, i.e., knowledge, metacognitive skills, and attitude. In earlier studies, students have shared that active student participation is essential in learning new concepts. It is apparent that underutilization of various high standard books during SGW occurs during our medical and biomedical science educational programs, both quantitatively and qualitatively. This underutilization seems to be due to the time pressure, lack of motivation, and poor preparation. As these are regarded to hamper active meaningful learning, strategies that could improve the learning are considered. This game-based learning feels more like entertainment than learning. Learners are usually motivated by active participation, interaction, and hands-on opportunities. The engagement between the learners encourages them to come back to learning again and increase their curiosity and interest to learn new concepts. While playing such games, the learner's gain immediate feedback of how much they have understood the concept and how much effort they must invest to learn more about the concept. They can also recognize their mistakes and correct them immediately as the feedback is instantaneous with such learning methods. As they learn the concepts then and there when the teacher teaches them, the concepts stay in their mind for a longer time, and it retains in their memory for a longer time. While playing such games, the learners also have the freedom to make mistakes and correct them without much guilt ness. They can experiment in a safe environment while playing such games. Learner's use their strategic thinking skills and plan and make predictions ahead about what might happen next. These kinds of games need the students to think on spot without any hesitation which is a great skill which helps them throughout their lives. The game-based learning environment results in higher retention rates compared to book learning. They can also work on spatial skills and fine motor skills. Interactive games help learner's to do this in an integrated learning environment. This learning enhances the essential life skills such as cooperation and teamwork. The knowledge and skills acquired through game-based learning are retained longer than information from other learning methods. This type of games also helps to strengthen the attentiveness to subject matters. It provides better focus and awareness which leads to greater memory recall in participants. Games usually boost the energy of the room to catch the participant's attention and provide opportunities for peer interaction. The instructors also have greater control over the presentation material and their learners' focus, which leads to less time needed for training and a higher learning curve. Many such games are designed to be simple to use and customize while incorporating invaluable information to keep engagement and informational retention high. Games provide an opportunity to be creative and innovative, which can lead to new ideas. The material is more comprehendible when placed into an enjoyable atmosphere and learners are highly engaged by such games. Games provide a safe and contextual environment to help students learn different skills, such as hand-to-eye coordination, to more complex skills such as problem-solving and strategic thinking. Motivation is the key element behind the success of game-based learning. Points and leader boards are often used in games because they are extremely motivating for learner's to accumulate points and achieve high ranking positions. Games are designed to mimic real-world

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scenarios. As mentioned earlier, a game mimicking flight simulation will greatly enhance a budding pilot's flight skills, while a game that explores the human body will be able to provide useful knowledge of biology. Thus, skills acquired during game learning can be applied to real practice. The "learn by doing" approach has a significant impact on the student in terms of making their learning stick, rather than the learning that comes from reading a book, only to be forgotten over a short period. As well as providing real-time learning, tasks within games are often repetitive. Repetitions of practice help to strengthen the memory as well as deepen understanding of a particular practice. Game-based learning is tailored to each learner's ability to absorb the information. Everyone learns at a different rate, with some picking up new practices faster and others slower, while some understand certain concepts easier than the next person. In traditional learning methods, such as teaching in the classroom, everyone in the classroom learns together, but each student moves forward at different pace. In this way, students who learn faster become bored, while those who are slower in picking up concepts struggle to catch up. Game-based learning allows each person to learn at their own pace. Its only when the basics are mastered that the player can then move on to more complex problems to solve. As a result, there is no danger of the student feeling overwhelmed by the pace or complexity of whatever is being taught, as occurs in traditional education learning. One of the key aspects of game-based learning is that each learner receives immediate feedback on their performance; with suggestions on how they might improve. This is an advantage over classroom-based learning, where students may have to wait sometime before receiving any feedback at all. In a traditional setting, grades can provide students with some very loose feedback on how they have performed in the examination, but the feedback is not fully effective because it does not present any real information with regard to performance. By the time grades are awarded, it is too late for the student to do anything to correct their mistakes. With that in mind, it is imperative that ongoing feedback is given while the learning is taking place. Game-based learning provides the perfect platform with regard to continual feedback. Immediately, students are informed of how well they are performing, which areas they need to improve, and how they might go about making those improvements. On a psychological level, students foster the desired behaviors in relation to working toward solutions in the face of a problem, and they also learn to adjust their approach whenever their behaviors lead them to making mistakes.

Motivation is one of the key aspects of game-based learning. Before we learn anything, we have to be motivated. We also need to be exposed to relevant material that will facilitate learning. Games enable us to do that, as they quickly cultivate knowledge and equip us with the skills to progress. Point systems and leader board rankings motivate us to work toward a sense of achievement. Furthermore, games allow the learner to experience time flow; there is no awareness of time passing, and hence, they become focused and "in the zone." Further, the fun of engaging in game-based learning means that people want to spend more time with it. When we are learning in a conventional manner, it can take some time before we even realize the mistakes we are making, let alone how to fix them. In games, feedback is immediate and any negative consequences from mistakes made will not impact on the real world. If we make a mistake while flying a plane through a simulator, the process can simply start again. If we make a mistake while flying an actual plane, it can have disastrous consequences. Through game-based learning, people are able to recognize mistakes almost immediately through the feedback that is provided and are in a position to fix them much more quickly. Traditional learning focuses on teaching students what to do, but this is not the most effective way to learn. A better way to learn is through practice and experience. Games provide experiential learning that allows for an authentic learning experience. Learners are placed in the driver's seat and get the chance to reflect on how they have performed, and that's where learners begin to develop. By actually performing in game simulations, people learn from a full, holistic experience of learning as everything is taking place in real time. Through practice and experience in games, the learner gains some useful experiences on how to do rather than what to do.

Games create a learning environment where progress is key – not winning a race. Players are allowed to learn at their own pace to master basic knowledge before progressing to more difficult concepts. It is not like traditional classroom learning, where learners in a group need to work through more difficult tasks together, resulting in some students not being able to understand basic concepts before moving on to more complex problems. Games provide knowledge, from basic to more complex knowledge, where students finish each game level, making tasks progressively challenging. A vital component of effective learning lies in ensuring students can move at their own pace, rather than being swept along by the tide and losing their way.

CONCLUSION

This study shows that there is a significant increase in the marks obtained by the students who learned by playing bingo puzzle game. Thus, this type of active learning methods helps students to understand pathology effectively.

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Conflicts of interest

There are no conflicts of interest.

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