

Original Article



Design, Implementation, and Evaluation of an Educational Application in the Quality of Students' Learning in the Cardiac Surgery Technology Course

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Abstract

Background: There are various methods for teaching content, which is the most common lecture method with the most minor retention in teaching. Innovation in basic science teaching methods is needed to keep up with the ever-changing landscape of technology. The purpose of this study was to design, implement, and evaluate an educational application (gamification) on students' learning in the course of cardiac surgery technology.

Methods: This study is applied research in this project in which we intended to make the concepts of cardiac surgery technology understandable, enjoyable, and easy for students using an educational application (gamification) method. In this study, an educational application was created and provided to the students. Finally, three areas of student perception of learning, their scientific ability, and their educational atmosphere were evaluated via the Dundee Ready Educational Environment Measure (DREEM) questionnaire.

Results: According to the demographic findings, out of 110 samples, 65 (59%) were female students, and the mean age of the participating students was 21.23 ± 2 . The application was compatible with the Android operating system. It consisted of three parts investigating anatomy, surgical procedure, and cardiac surgical instruments and other parts investigating search, game guide, and participants' points. Students' learning and learning environment were evaluated as high (good picture of learning). Regarding the learning dimension and educational atmosphere, the highest score was related to the learning dimension (45.1). Moreover, there was no statistically significant difference between the mean perception scores of male and female students.

Conclusion: With the advancement of technology and industrialization of different societies, the use of new learning methods will be highly effective in educating students. According to the results of this study, students' satisfaction with this educational application in cardiac surgery technology course indicated that this application upgrades and improves the learning of new teaching methods and motivates students to participate in the classroom. In other words, applying educational content can be fruitful.

Keywords: Student perception, Learning environment, Gamification, Application, Surgery, Heart



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Introduction

Teaching is a set of preplanned activities to create learning in the learner, which takes place in the form of an interaction between a teacher and a learner. Familiarity with and applying the methods, techniques, and teaching approach tools lead to the easier achievement of educational goals in a shorter period. Teaching methods are abundant, but choosing the right one plays an influential role in the success of teaching (1).

There are several methods to transfer scientific content,

and the most common is lecture in which the least retention of information lasts for a short time in mind. Innovation in teaching methods of Basic Sciences is a need to keep up with the rapidly changing technology landscape. On the other hand, due to the increasing growth of information and communication technology, the current traditional education methods do not meet the educational inquiries of today's societies. Nowadays, with the increasing use of telecommunications, teaching tools and methods are also evolving. This technological advancement has led to the



introduction of newer tools for knowledge transfer (2).

Using games as a part of teaching methods may enhance learning by creating a dynamic learning environment. Lecturers in the field of healthcare face several challenges. In other words, using ordinary educational methods for information transfer (e.g., lecturing) in the educational process is often tiresome and reduces the focus on learning (3). In all experiments, students who participated in an educationally designed game performed better on assessment. According to 98% of students, this game supports the learning process. The data showed that the educational game improved students' understanding of action potentials (4). Today, teachers consider gamification as one of the most effective learning methods. Gamification techniques use elements and principles of gaming to create an engaging learning experience and to increase efficiency and user interaction (5).

Gamification is rapidly becoming a trend in healthcare education. Many scientific studies showed the progress of this method. The use of this new teaching method has increased almost tenfold in the last five years (6). Currently, gamification is one of the techniques that can increase motivation and participation, especially in fields of teaching and learning, which require entertaining activities. Gamification has been a topic of discussion in recent years, which can be used to increase the efficiency and interaction of users. Using this method in educational environments leads to more effective teaching. Literature reviews indicated that the term "Gamification" was coined back in 2002 but was not widely accepted until 2010. The concept was introduced in 2005 in digital media. Gamification is a new method of game principles and game-design elements in non-game contexts. In this concept, gamification dramatically increases learning by increasing the motivation and interaction of learners. Implementing such a concept is not a straightforward process and may be complicated (7).

In the old and traditional methods, medical students learned skills by observing a surgeon; therefore, there were unequal opportunities for practice in the clinical environment between students. This inequality in training chances led to dissimilarities in skill levels. In addition, the poor access of faculty members to new methods was a limiting factor in teaching medical students and adequate preparation for internship courses. However, training courses are now available on video conferencing platforms (8). Technological innovations such as various applications in all fields play a significant role in educational programs today and are recognized as practical tools for education (9).

After completing theoretical credits, surgical technology students face real patients in the form of internship training. Students' proficiency and skills in teaching increase their level of awareness of surgical techniques. This study aimed to investigate the possibility of designing an application for heart surgery techniques that will enable active people to exercise in an attractive environment and

create more lasting learning. Improving the quality of medical services to patients would be the final output of this study. Accordingly, this study aimed to design, run, and evaluate an educational application (Gamification) to find out its impact on the learning efficiency in the heart surgery technology course.

Materials and Methods

This study is a type of applied research in which we intend to make the concepts of heart surgery technology courses understandable, attractive, and easy for the target students (surgical technologists) using an educational application (Gamification) method. The community under investigation included students of surgical technology, in the Department of the Faculty of Nursing and Midwifery at Beheshti University of Medical Sciences. Participants in the study were evaluated by the census method, which means that all students having the heart surgery technology course were included in the study. The designed application was used under the supervision of the relevant professor. In a theoretical session on the topic of coronary artery bypass graft surgery, after a short explanation, each student filled out the questionnaire in the application. The questionnaire contained 30 questions examining students' perception of learning, their academic ability, and the educational atmosphere of the Dundee Ready Educational Environment Measure (DREEM) questionnaire, which was numbered based on the Likert scale ranging from zero to four. Zero scores are defined as the lowest and four as the highest. The validity and reliability of the DREEM questionnaire have been reflected in previous studies (10). Each of the areas is divided into four according to the maximum scores. For example, the maximum score of the learning dimension (i.e., 48) indicates a score range of 0-12, suggesting a low attitude toward learning. A score range of 13-24 means a negative attitude toward learning, a score range of 25-36 shows a more positive attitude, and a score range of 37-48 denotes a good picture of learning (11). Furthermore, the total number of scores in the three investigated areas is 128, where a score of 0-32 means a weak attitude toward concepts, 33-64 means a negative attitude toward learning concepts, 65-97 indicates a more positive attitude, and 128-98 suggests a good attitude and perception of learning.

To identify the strengths and weaknesses in the educational and learning environment, expressions with an average score of 3.5 and above were considered positive points, and any expression with an average score of 2 and below indicated problematic areas; moreover, expressions with an average score between 2-3 indicated aspects of the educational environment that needs to be strengthened. The educational content of this application was designed in the form of multiple-choice questions and blank spaces in the two sections of knowledge and lesson concepts. The other part of the work consisted of pictures related to surgical instruments, heart surgery, and anatomy lessons. In the technical design phase, the following items were

monitored based on the elements that are considered in game development.

Various technical facilities were designed to increase the attractiveness, efficiency, and purposefulness of the game related to the educational goals, including the possibility of customizing the game for users, the possibility of monitoring students/users by professors, levels, points earned for students, and other elements. The application development team included the scientific team and the technical team. The scientific team prepared the educational content based on the specified topics and provided it to the technical team, and the technical team implemented the application design steps. During the execution of the work, there was constant interaction between the scientific and the technical teams. After the initial design of the game and running the prototype, based on the evaluation of early users, the possible problems and issues were resolved, and the additional suggestions of the users were taken into account. After presenting the educational content according to the planned sessions, the students referred to the designed application, namely, gamification. Afterward, descriptive and inferential statistics were used to analyze the data of this research. To describe students' perceptions of the educational environment, the mean and standard deviation were used, and to compare the means in two independent samples such as the gender variable, independent samples *t* test was used.

Results

The first phase of this study was conducted to examine the demographic findings. The data indicated that 65 (59%) of the 110 studied samples were female students, and the average age of participating students was 21.23 ± 2 . The designed application is compatible with the Android operating system. Figure 1 indicates the user's environment. The menu consists of different parts: three parts are related to the questions, and others are related to the search, game guide, and participants' scores. If the user answers the question correctly, it will show an encouraging emoji, and if the answer is wrong, it will show an upset emoji, as depicted in Figure 2.

The maximum scores of the dimensions, the averages, and the scores are presented in Table 1. According to Table 1, the participants evaluated the learning environment at a high level; therefore, the scientific ability of the participating students in the study was indicated at a high level. Moreover, comparing the learning dimension and the educational atmosphere, the highest score was related to the learning dimension (45.1). According to Table 2, there was no statistically significant difference between the average perception scores of male and female students.

Discussion

The purpose of the current study was to design, implement,

and evaluate an educational application (gamification) to determine the learning rate of students in the heart surgery technology course. The results of this study showed that there is no significant difference in the learning and the educational atmosphere in terms of gender while using this application. Learning and the educational atmosphere scored approximately the same. Based on the students' evaluation of the learning and teaching environment, the application received a high score. The research findings revealed that the use of gamification is effective in students' learning, which is aligned with the findings of the study by López-Jiménez et al. They investigated the effect of gamification on students' learning in the Anatomy course to find out the effects of three student learning systems: expression, participation, and motivation. The results of López-Jiménez and colleagues study showed that students who used the game to learn the course performed better academically compared to the control group (12).

In another study, Munusamy et al aimed to use digital games to train professionals. The results of this study revealed that educational tools can provide a challenging simulated environment ideal for surgical training. In conclusion, games seemed to be effective in reducing medical errors and subsequent healthcare costs. Students are in favor of using online educational tools and believe that using interactive learning tools enhances their learning experience. Pharmacy students at Qatar University observed that integrating online technology into pharmaceutical science courses increases interactive learning in the classroom atmosphere (13).

In a study conducted by Honari et al, they aimed to investigate the effect of training strategic thinking on the country's sports managers through gamification. The findings suggested that educational methods have strong effects on their learning and motivation, which indicates the higher impact of gamification in learning strategic thinking in comparison with traditional methods (7).

In another study, Abdulmajed et al aimed to investigate the effect of the aging game on students' attitudes toward the elderly population. The aging game was a simulation learning activity that tried to change attitudes, and improve empathy with elderly people, as well as experience working with elderly conditions such as hearing, vision, and mobility loss. The results before the intervention showed that the students generally have a higher level of anxiety in terms of aging and a negative attitude toward it. After the intervention, the students experienced a lower level of anxiety and negative attitude, and most reported having a positive attitude toward aging (3).

A clinical trial study was conducted by Luchi et al to investigate the effect of the game against the traditional method to improve the learning of triage tasks. The results of this study displayed that the accuracy of performing triage in the group under training was higher than that in the control group, and in terms of choosing the correct steps, they were more accurate. However, the spent time for performing the tasks was not significantly different (4).

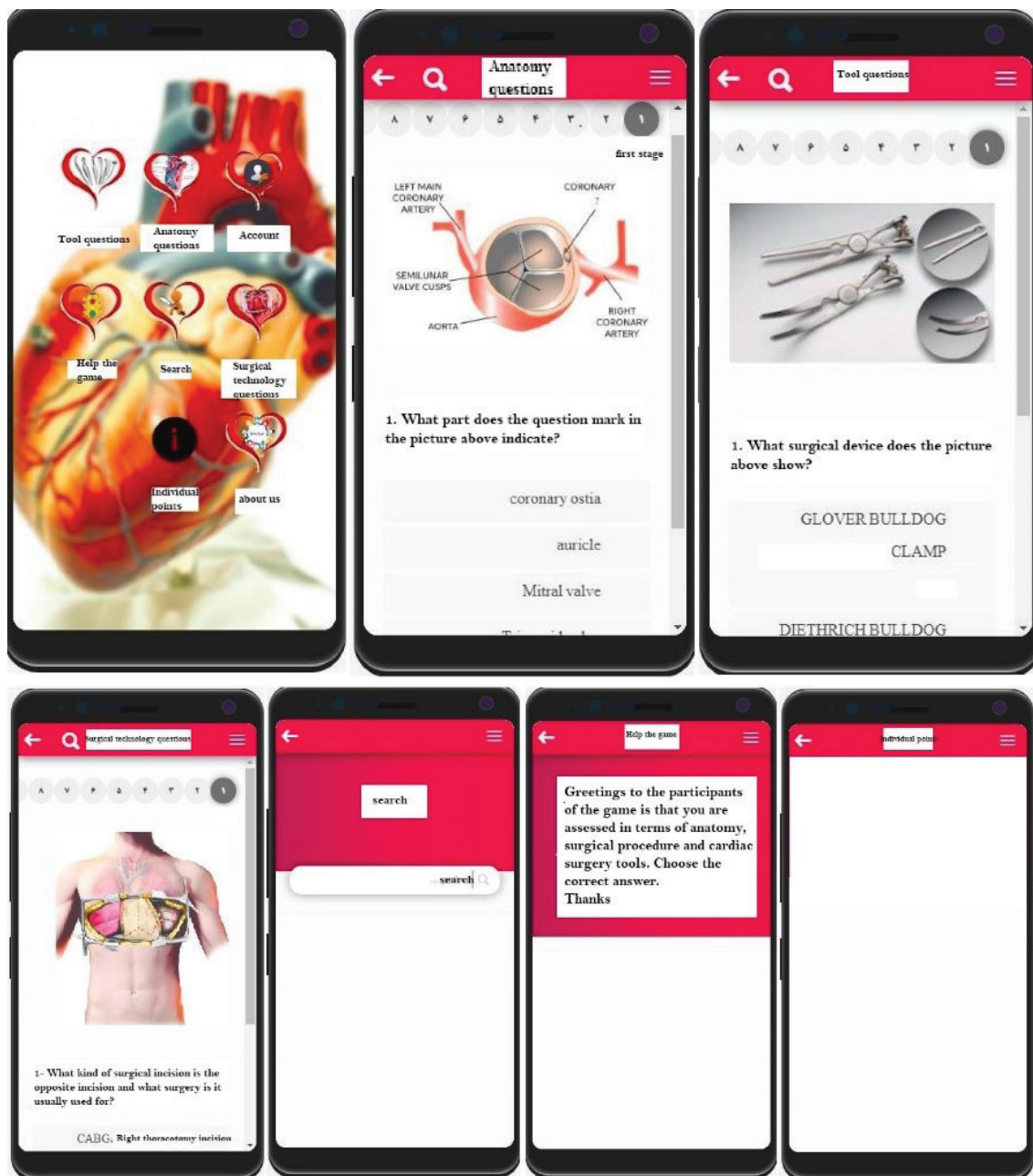


Figure 1. Images of the User Interfaces. *Note.* In the menu-driven interface of the application, three parts are related to questions, and others are related to search, game guide, and participants' scores

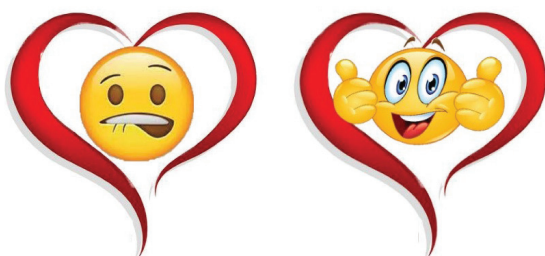


Figure 2. Emojis Representing Students' Answers

Another clinical trial study was designed and conducted by Amini Far et al to investigate an educational game on general practitioners regarding primary care compared to the traditional method. The purpose of this game was to improve the initial judgment of diabetes mellitus

treatment with insulin. The results showed that using games in terms of education is a suitable solution to increase the knowledge and care of the patients (14).

Telner et al in their study strived to examine the effects of virtual games on creating motivation and determining the obstacles in using virtual reality to improve hand, arm, and finger movements. The results suggested that the level of operating virtual reality at home is different, and the time may be shorter. There are also obstacles to using the equipment for patients, but the system can create motivation (15).

The results of the studies conducted on the effect of applications in various fields have a positive effect on the education of students, which is consistent with the results of this study. However, despite the positive effect of this

Table 1. The maximum score, the average score of perception, the standard deviation and the percentage of the score obtained in the dimensions of the learning and educational environment and the general environment of education.

Dimensions of the Educational Environment	Maximum Score	Overall Mean Perception \pm Standard Deviation	Earned Scores
Learning	48	3.6 \pm 0.34	45.1
Scientific ability	32	4.1 \pm 0.43	30.4
Educational atmosphere	48	4.5 \pm 0.23	40.2
The general environment of education	128	4.06 \pm 0.35	125.8

Table 2. Comparison of the Mean Scores of the Learning and Educational Environments' Perception Dimensions According to Gender

Gender	Learning	Scientific Ability	Educational Atmosphere	General Learning Environment
Men	36.5 \pm 0.23	35.2 \pm 0.3	40.1 \pm 0.1	37.26 \pm 0.35
Women	37.1 \pm 0.35	38.2 \pm 0.4	41.2 \pm 0.23	38.83 \pm 0.4
P value	NS	NS	NS	NS

Note. N.S: Not significant.

type of training, there is no question and answer between the learner and the trainer, which increases the learner's understanding and can be regarded as the most important shortcoming of this type of training.

Conclusion

With the advancement of science and technology and the industrialization of societies, the use of new learning methods seems to be extremely effective in the education systems. Moreover, according to the results of this study, students in the course of heart surgery technology were extremely satisfied with this type of educational application. For students, education will be enjoyable when they receive the most content in the shortest time, and this has been confirmed by the use of the gamification method in various studies. To promote and improve learning, the use of new teaching methods can create motivation in students to participate in the application classes. This method makes educational content more fruitful.

Strengths and Limitations

One of the strengths of this study is the examination of three educational dimensions of students (student perception of learning, student perception of their academic ability, and student perception of the educational atmosphere), which determines how much students have understood through the application of modern education. Another strong point of this study is the visual nature and game mode of the training in the application. However, the lack of access to smartphones among students is one of the limitations of the current study.

Authors' Contribution

Conceptualization: Atlasi Safaei.

Data curation: Homayoon Bana Derakhshan.

Formal analysis: Reza Salehina.

Funding acquisition: Reza Salehina.

Investigation: Reza Salehina.

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Supervision: Homayoon Bana Derakhshan.

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Writing—review & editing: Marzieh Nasiri Sangari.

Competing Interests

The authors also declare no competing interest.

Ethical Approval

All experimental procedures were performed in strict accordance with ethical standards, including maintaining the confidentiality of the information of the involved society. Furthermore, the study was approved by the Ethics Committee of the Mazandaran University of Medical Sciences (Ethics code number: IR.MAZUMS.REC.1401.114, Sari, Iran).

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