



Designing PharmQuiz Educational Game Application to Facilitate Learning of Pharmaceutical Information for Pharmacy Students

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Received: 2020-12-27, Revised: 2021-01-13, Accepted: 2021-02-27, Published: 2021-03-30

ARTICLE INFO

Article type:

Original article

Keywords:

Games, Experimental;
Mobile Applications;
Education, Pharmacy;
Students, Pharmacy

ABSTRACT

Background: Serious games are the addition of game elements in order to motivate the user to participate more in the learning process. The purpose of this study is to design PharmQuiz educational game application in order to learn pharmaceutical information in the introductory internship course of pharmacy for incoming pharmacy students in 2020.

Methods: After reviewing the studies, the puzzle and matching mechanisms were selected for the game. The RAD software design model was used in order to design and implement, the game application was coded in Java programming languages. The game engine is unity and MySQL and PHP languages were used to implement the game database, which contains learners' scores.

Results: A total 70 students participate in the study. The mean age of the study participants was 22 years. Average student scores show that most students have used the PharmQuiz game app repeatedly. A survey of faculty members of the Clinical Department of the School of Pharmacy showed that 100% of the members agreed that the game improves the quality of learning.

Conclusion: According to the positive attitude of students regarding the PharmQuiz educational game application and their welcome in using this application, it can be said that PharmQuiz game application is a useful tool to increase the motivation of students to study the introductory internship course of pharmacy and also to participate more in the educational process. This application can be used at higher levels as well as for learning pharmaceutical information in other medical sciences.

J Pharm Care 2021; 9(1): 18-23.

► Please cite this paper as:

Izadpanah M, Eslami K, Jamshidi Ardekani R, Kouti L. Designing PharmQuiz Educational Game Application to Facilitate Learning of Pharmaceutical Information for Pharmacy Students. J Pharm Care 2021; 9(1): 18-23.

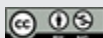
Introduction

Educational play is a method that requires the learner to participate in a competitive activity with predetermined rules (1). Game-based learning can provide an attractive and highly engaging session because students, as players, cooperate and participate to solve various game challenges (2). There are many potential benefits in educational games and there is evidence that there are positive learning outcomes through virtual simulations. In addition, games, mobile apps, and simulated virtual patient offer students opportunities to practice lessons (3). Teaching courses in the fields of medical sciences are the most common field for serious games (4). Game-based learning in medical education is a valid

alternative to traditional teaching methods. Serious games, if well designed, use non-threatening competition to increase an individual's motivation for active and dynamic involvement and presence (5). Many pharmacies course programs can be suitable for serious games (6). Due to the limitations of traditional education and the benefits that combined education brings us, we can take advantage of the capabilities of new technologies (7). Learning through play must be done through mechanisms such as puzzles and quizzes and educational components must interact with these learning mechanisms. It can be seen that these game mechanisms are effective in learning (8). Mobile technologies have a great impact on increasing learning activities in medical education,

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although, advances in technology may not create sudden milestones in student education, they do provide many opportunities for medical professors and students (9).

The epidemic of covid 19 has caused many changes in educational practices around the world. Therefore, many universities offer their courses and curricula entirely electronically (10). The social distance created during the Covid 19 epidemic has created educational barriers for students which students' self-confidence is maintained and strengthened by engaging students with a serious game as an alternative, and this educational barrier becomes less (11). The introductory internship course of pharmacy aims to get acquainted with the basics of urban pharmacy and pharmacist services, prescription reading, work processes and familiarity with applied pharmaceutical information (12). Due to the large amount of information in the introductory pharmacy internship course and the difficulty in memorizing the names and other information of the drugs in a period of one semester, learning more and more helps to empower future pharmacists (13). At present, due to the lack of face-to-face courses as well as the large volume of pharmacy introductory internship materials, new technologies and teaching aids such as serious games can be used to improve the learning of drug information. This educational game is designed to cover the familiarity with drug information in the introductory internship course and include pharmacological information related to most of the drugs available in Iran and as an educational aid tool to achieve the objectives of the introductory pharmacy internship course. The purpose of this study is to design PharmQuiz educational game application to facilitate learning of drug information for pharmacy students of Ahvaz Jundishapur University who have taken the introductory internship course in pharmacy.

Methods

First, the game application design was registered at the university and as a part of a dissertation, its code of ethics was approved. In order to design the game mechanism, two methods of puzzle and matching were used. These two game mechanisms were selected based on studies. The purpose of this game is to facilitate the learning of drug forms available in the Iranian Pharmacopoeia, which pharmacy students should learn in the introductory internship course of pharmacy.

PharmQuiz game application design:

Rapid Application Development Methodology model has been used to design PharmQuiz educational game application. Based on the RAD model, the following four steps were performed to design the game application:

Phase 1: Planning Requirements

Planning was done based on the topics set for the introductory pharmacy internship course in a group consisting of pharmacy introductory internship professors and experts from the Virtual Training Center of the University Medical Education Study and Development

Center in accordance with the standards of the Virtual Training Center. Drug information sources include generic name, brand name, category and subcategory of drugs, drug forms and indications of drugs based on available pharmaceutical sources including sites such as Dailymed.gov, Medline plus, FDA.gov, applications including Medscape, Drugs.com, Uptodate, TTAC, Lexicomp, and Micromedex drug reference and extracted based on AHFS classification and prepared in a suitable format.

Phase 2: Design and presentation of a prototype

The game is designed in such a way that each stage includes one category of drugs. Each stage, in addition to the competition mode, also has an unlimited training mode. In the training part, which is only for repeating more medication information, no scores are awarded to the user. The game was designed in two forms: puzzle and matchmaking. In the puzzle section, the user must drag and drop the correct information of each drug in its correct place and in the Matchmaking section, the user must move the information in front of each drug correctly to put the correct information of each drug in front of it. The game is designed to attract more students and increase the excitement and motivation to participate in such a way that students can compete with each other. For this purpose, there is a section called the leaderboard where the scores of the individual and other students are shown. The order of scores is in descending order.

Phase 3: Phase of making and testing PharmQuiz educational game application

The game is written by Unity game engine and in Java programming language. Due to the large amount of information in the introductory internship, JSON software is used to classify this information, which is object-oriented and compatible with the Java language. The game interface is a bridge between the game and the user, which if not designed properly, it will reduce the user's motivation to play. As a result, it is very important to be rejected or approved by the user so it was tried to create the right interface, which was designed by Adobe Photoshop and Adobe XD and then transferred to the Unity game engine. MySQL and PHP languages were used in order to design and implement scores and member names on the server.

Finally, the game application was integrated and assembled, tested in several stages by different users and Software bugs, including crash problems and game bugs and its apparent flaws were given feedback and these bugs were fixed.

Phase 4: Delivery phase

At this stage, educational videos on working with the game application were prepared and published together with the PharmQuiz game application at the address <https://pharmassistant.ir/pharmquiz/> and Cafebazar.

Satisfaction and Survey

A reliable and valid questionnaire was completed to survey the teachers of the pharmacy internship course to evaluate the PharmQuiz educational game application. Its

validity and reliability were examined by other professors who did not participate in the study. The justifiability of the questionnaire was finally confirmed with CVI = 0.796 and its reliability with Cronbach's alpha 0.89.

Questionnaire was completed by the 10 professors and instructors of the introductory pharmacy internship course and they were asked about the strengths and weaknesses of the PharmQuiz game app.

Results

Presenting PharmQuiz game application

PharmQuiz educational game application has 12 steps and each step covers one of the pharmacy internship sessions. In the competition part, each stage includes 16 puzzles and 4 matchmakings, each puzzle contains information about

two drugs. The correct information of each drug must be put in the right place by the user. Each matchmaking also contains information on 4 drugs that are arranged randomly and must be placed in the correct place by the user. Scores are visible in the leaderboard and are arranged in descending order. In the training part of the game, the number of puzzles and matchmakings are less limited and students can choose this part to practice more and learn more. In this case, they are not given scores and it is only for repetition and more learning. PharmQuiz educational game application can be downloaded through the link <https://pharmassistant.ir/pharmquiz/> and "Cafebazar". This version can be installed on mobile phones with Android operating system. Below are pictures of the PharmQuiz game application. (Figures 1-5)

Figure 1. The first page of the game app.

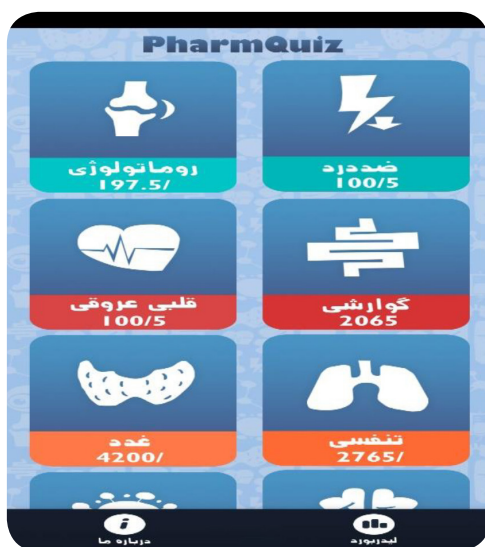


Figure 3. puzzling

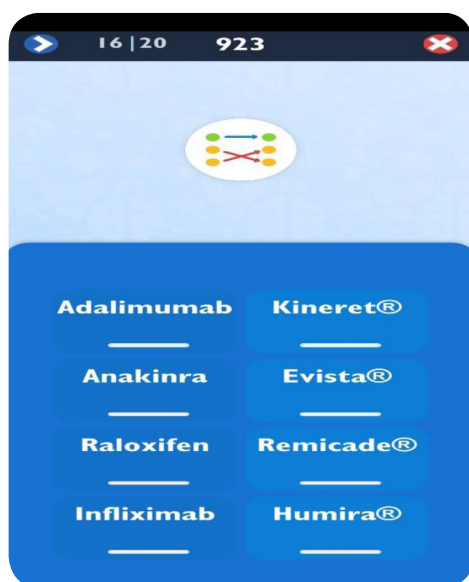


Figure 2. Racing and training mode.



Figure 4. Matchmaking



Figure 5. Leaderboard



Technical evaluation of the game "PharmQuiz"

For technical review, the game was sent to organizations such as Khuzestan Science and Technology Park, Khuzestan University Jihad Growth Center, Shahid Chamran University of Ahvaz Growth and Computer Technology Center, as well as game-startup and Khuzestan Science and Technology Park (Diaco Company). In addition, for general review, the game application was sent to "Cafebazar" and was technically and security-wise approved by "Cafebazar".

Scientific evaluation of PharmQuiz game

A survey of professors and instructors of the introductory pharmacy internship course showed that the game can improve the quality of education (Table 1).

Student participation

Seventy of seventh semester student of pharmacy were included in the study, 40 of whom used the PharmQuiz game app. Examining the number of times of the game and the highest scores, it was found that the average student use of the game was 70 times per student, which shows the great acceptance of students from the PharmQuiz game application.

Table 1. Results of professors' surveys

	Question	Strongly Agree	Agree	Unsure	Disagree	Strongly Disagree
1	The game covers all the information and topics of the introductory internship	40%	60%	0	0	0
2	The steps of the game are understandable	40%	30%	0	20%	10%
3	The information is up to date and accurate	40%	60%	0	0	0
4	The appearance of the game is attractive enough	40%	20%	20%	10%	10%
5	This game can increase a learner's motivation	80%	0	20%	0	0
6	The game has enough simplicity and fluency	60%	10%	20%	10%	0
7	The game has the necessary adequacy and capability in conveying the curriculum	40%	40%	20%	0	0
8	Game education can improve the quality of learning	100%	0	0	0	0
9	Training through games makes you better acquainted with the forms of medicine	20%	60%	20%	0	0
10	Play can increase students' self-confidence	60%	30%	10%	0	0

Table 2. Survey of students

	Strongly Agree	Agree	Unsure	Disagree	Strongly Disagree
The steps of the game are understandable	50%	32.85%	5.71%	5.71%	5.71%
The appearance of the game is attractive	45.71%	25.72%	17.15%	5.71%	5.71%
The game has enough simplicity and mentality	40%	45.71%	11.43%	0	2.86%
The game has a convenient and understandable guide	40%	25.72%	11.43%	22.85%	0
The game has increased the motivation to study the introductory course of pharmacy	60%	30%	10%	0	0
The game is better acquainted with the basic drug information	50%	34.29%	15.71%	0	0
PharmQuiz game makes learning better medication information	57.14%	34.29%	5.71%	2.86%	0
Game education can improve the quality of learning.	45.72%	50%	4.28%	0	0
Learning through PharmQuiz is more fun for me than traditional study.	57.14%	28.75%	21.43%	2.86%	0
PharmQuiz game increases self-confidence in the field of medication information.	40%	45.71%	11.43%	2.86%	0
I prefer to learn other related lessons through the game app.	45.71%	40%	14.29%	0	0

Discussion

The use of game development in higher education has increased significantly. Positive attitude and good experience make students eager to use educational games (14). In the present study, an educational game was used to facilitate the learning of drug information to pharmacy students and the results of a survey of students show that more than 90% of students believed that the game has made students better acquainted with drug forms. Game strategy in situations where there is time and space constraints can be a useful tool in training (15). This strategy is a useful tool for training, especially in the current context where the Covid 19 crisis has made face-to-face training impossible worldwide. We used this strategy as a teaching aid tool in the introductory internship.

Learning through two mechanisms of competition and puzzle in games can be effective and cause the user to use the game a lot (8). We also used these two mechanisms in this study and the results of this study are consistent with our study and the number of times students have used the game application has been enormous.

Games have the potential to engage students in the learning process and enhance student learning (16). We have also sought to involve students more in learning and improving learning and as the highest score as well as the average game usage (70 times per student) shows, students have been very involved in the learning process. Using games can make learning better and faster, improving cognitive functions such as memory and reasoning, improving concentration

and recall, motivating and making the learning environment quite fun. (17). In this study, the game application has created an active learning environment in which students spend times of the day playing games with the PharmQuiz application in order to learn medication information. Also, more than 90% of students believed that games improve the quality of learning.

Using games can improve brand and generic drug learning (18). In this application, the game practices and repeats drug information, including generic and trade names and other drug information, and causes students to remember more drugs.

A study (19) found that the unlocking system and scoring is one of the most popular game application strategies. Also, the competitive nature of the game stimulates learners to play (20). In this application, the scoring system has been used to increase the motivation of students to use the game application more.

Due to the high participation of students and their high use of the game application and the results of the professors' survey, it can be said that the game application can cause more students to participate in learning and improve the quality of education. Therefore, the game application can be used as an educational tool in teaching the introductory internship course of pharmacy. It is also possible to use similar applications in teaching other pharmacy courses, especially in the current situation where it is not possible for students to attend.

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