Iran J Public Health, Vol. 53, No.2, Feb 2024, pp.443-452

Original Article

Using Modern Learning Method to Teach Pharmacy Students Psychopharmacotherapy

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(Received 18 Dec 2022; accepted 11 Mar 2023)

Abstract

Background: Applying modern educational methods for digital native students seems necessary. Active learning strategies promote students' skills and knowledge. This study was conducted to design and evaluate active learning methods by teaching psychopharmacotherapy to pharmacy students.

Methods: This was a quasi-experimental study with three randomized study groups (control, game, and multimedia), using a pre-and post-test design, conducted on 155 students of 5-year pharmacy in 2022 at the Faculty of Pharmacy of Tehran University of Medical Sciences, Iran. Overall, 18 clinical cases were designed for the basic structure of interventions. After teaching psychopharmacotherapy contents through lecturing, the pre-test was held. The next steps were playing the educational game, studying the multimedia case-based learning files, and then completing questionnaires, respectively. Then, a post-test was held.

Results: 65.33% of participants were female and 34.66% were male. The pre-test and post-test scores comparison showed no difference in control group (P=0.409). However, in the serious game and multimedia groups, the average score of pre-test and post-test had a statistically significant difference (P<0.001, P=0.002 respectively), this difference was higher in the serious game group. Questionnaire evaluation showed substantial differences between game and multimedia groups.

Conclusion: The educational interventions were able to improve student's knowledge and skills so they can better help patients and promote public health. In the sections of Confidence, Social Interactions, Fun, Focused attention, Learnability, Relevance, and Perceived Learning, the serious game far outweighed the multimedia case-based learning.

Keywords: Serious game; Pharmacotherapy; Active learning; Pharmacy education

Introduction

Considering today's world is surrounded by technology (1), it seems necessary to apply modern educational methods for digital native students (i.e. Z generation) (2, 3). Therefore, as to improve

the quality of pedagogical approaches, educators need to implement active teaching methods. Compared to the lecture, active teaching methods exhibit numerous advantages, such as the promotion of knowledge retention, critical and creative thinking, problem-solving skills, and communication skills (4). Different methods of active learning include simulations, role-play, group discussions, visual representations and models, problem based learning, case based learning, scape rooms, and games (5). Game development with the purpose of promoting students' knowledge is defined as educational game or serious game (6). Applying these educational methods will have a positive impact on public health outcomes by improving students' knowledge and skills (7).

Healthcare students as one of the main target groups of serious games could enormously benefit from an interactive learning platform that is able to provide a risk-free situation for practice and subsequently reduce healthcare costs by improving patient safety and minimizing costs (8). According to the policy of the Academic Affairs Committee in 2014-2013, American Association of Colleges of Pharmacy (AACP) supports the development of serious games to promote pharmacy education and increase interdisciplinary interactions. Therefore, if possible, pharmacy faculties include serious games in the curriculum to improve students' learning (9).

Due to limitations in financial resources, technical knowledge, facilities, and support, the production of serious games in Iran have not progressed along with other developed countries in the world (10). Based on a thorough literature review on serious games in pharmacy education in Iran, so far only one educational game for pharmacy students has been prepared, results of this study pointed out that this application increased students' motivation for the internship course (11).

Up to now, serious games have been applied in various subjects of pharmacy education, including Pharmacotherapy and non-pharmacotherapy topics (5). In the meantime, the most common game scenario was the community pharmacy (12, 13). In addition, psychiatry is one of the pioneer topics in the field of active learning methods (14). On the other hand, due to the high prevalence of psychiatric diseases and the subsequent high consumption of related medications, pharmacists play a substantial role in helping patients by providing appropriate drug counseling (15). To our knowledge, no game has been developed for pharmacy students to teach pharmacotherapy on psychiatric subjects.

In this paper, we report on the design and development of a serious computer game to teach pharmacy students on drug therapy for mental health issues and explain the design of a trial in order to evaluate whether the serious game has the potential to be educationally efficacious.

Materials and Methods

This was a quasi-experimental study with three randomized study groups, using a pre- and post-test design, conducted in 2022 at the Faculty of Pharmacy of Tehran University of Medical Sciences. In this study, the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (16, 17) was used for the development of the material learning on drug therapy for mental health issues consist of depression, schizophrenia, bipolar mood disorder and anxiety disorders.

Ethical approval was obtained from the ethics committee of Tehran University of Medical Sciences (TUMS) (IR.TUMS.TIPS.REC.1400.125).

Analysis

Following literature review, 15 sessions with the participation of seven experts including three clinical pharmacists, one medical educationist, one educational technologist, one programmer, game and graphic designer have been held, to reviewing and prioritizing the contents of the cases. The main issues raised include the primary concepts of pharmacotherapy education for mentioned psychiatric disorders and how these concepts could be expressed and translated into play and case-based learning.

Design

Eighteen clinical cases by considering medication's indications, side effects and their management, dosing, dosage forms, equivalent doses, precautions, relative and absolute contraindications, monitoring, medication use in pregnancy and lactation, drug and food interactions, mechanism of action, pharmacokinetics and pharmacodynamics were designed. The game design and development were done based on goal-based scenario, including 7 components: learning objectives, mission, cover story, role, scenario operations, resources, and feedback (18).

Serious game design

At the pre-production stage, this game (Pharm-PSY) has been designed in the first person from the perspective of a pharmacy student who interacts with patients, physicians, and nurses and solves the cases. According to the scenario, students play the game on the computer. Pharm-PSY is a serious action-adventure game in three-dimensional space. The story in Pharm-PSY was created to simulate the professional interactions in a psychiatric hospital setting to promote students' knowledge and help them to understand their role as part of a multidisciplinary team providing care to a patient.

Development

Serious game development

At the production stage, technical experts including graphic artists and software developers have designed the game. Game assets include graphics (characters, environments), background music, special effects and sound effects, designed optimally using the game engine software Unreal engine 4.26.2, Microsoft visual studio programming support software, and 3DMAX design software.
Some scenes of the game are shown in Fig. 1. For each patient based on the dialogue, a voice adapted to her condition and illness is recorded, the player experiences the real feeling of the patient's tone. Furthermore, players can read written dialogue, lab tests, select options, and answer quizzes. Every case contains several multiple-choice questions that the player should consult the psychiatrist and answer multiple choice questions to get a score. Instant feedback is given by the pharmacotherapiest, immediately after answering each question.

Fig. 1: Some scenes of Pharm-PSY game

Multimedia case-based learning design and development

According to Meyer's principles (19), multimedia files were designed for each topic, which include cases, the professor's voice, related images and animations, multiple choice questions, instant feedback on the correct answer, and score for each correct answer. Four multimedia files were designed using Articulate Storyline 3 software.

Implementation

Overall, 155 five-year pharmacy students taken pharmacotherapy course according to the curriculum were recruited for this study. Students voluntarily participated in the study. After teaching four sessions of depression, schizophrenia, bipolar, and anxiety disorders through lecturing, the students were randomly allocated into 3 groups by block randomization method with a block size of 3 and 6: control group (n= 52), game group (n= 50), and multimedia group (n= 48). Two weeks before the implementation of educational interventions, a pre-test with 20 multiple-choice questions was held for all students participating in the study. Next steps were playing the educational game by the game group, studying the multimedia case-based learning files by the multimedia group, then completing questionnaires, respectively. Two weeks after the implementation of educational interventions, a post-test with 20 multiple-choice questions was held.

Evaluation

A comparison between pre-test and post-test scores were drawn to compare the effectiveness of education through multimedia case-based learning and serious game in comparison to lecture method.

To evaluate player experiences and usability, modified qualitative questionnaires with Likert scale MEEGA+ (Model for the Evaluation of Educational Games) (20) was investigated for game and multimedia. As far as reliability is concerned, the Cronbach alpha coefficient was measured for each modified questionnaire (Cronbach's alpha for game questionnaire was 0.84 and for multimedia questionnaire was 0.87). In order to compare the responds to the questionnaires related to the serious games and the multimedia, the number 1 was assigned to the statement "I agree", 0 was assigned to the statement "neither disagree nor agree" and -1 was allotted to the statement "I disagree".

Statistical analysis

Quantitative data were reported as mean (±SD) or median (IQR) based on parametric or non-parametric data, respectively. Qualitative data was reported as frequency (percent). All analysis was performed using Stata software version 13 and SPSS ver. 24. A significance level of less than 0.05 was considered. The mean comparison of continuous variables with normal distribution was done with paired T-test. One-way ANOVA and post-hoc tests were done for 3 group score comparison. Mann–Whitney U test also was used for variables with non-parametric distribution.

Results

The study population consisted of 150 fifth year pharmacy students in total. Among them, 98 (65.33%) were female and 52 (34.66%) were male. The average age of the participants was 22.73 (±2.36) years.

According to the survey in the game group, 14% played daily, 26% weekly, 12% monthly, 42% rarely and 6% never played digital games. As for non-digital games, 4% played daily, 18% weekly, 28% monthly, 42% rarely and 8% never played any games.

Statistical analysis showed that the difficulty coefficient (P=0.06) and the discrimination coefficient (P=0.29) of the pre-test and post-test questions were not significantly different.

One-way ANOVA test showed that there was no significant difference (P=0.61) in the comparison of the average pre-test score among the control (6.84±2.26), game (6.82±2.31), and multimedia (7.20±1.90) groups.

Moreover, the comparison of the average score of the post-test among the groups of control (6.55±2.24), game (8.73±2.34), and multimedia (8.33±2.53) showed a significant difference (P<0.001). The post hoc test shows a significant difference between the post-test scores of the control and game groups (P<0.001) and the control and multimedia group (P<0.001).

In the control group, the average score for pre-test (6.84±2.26) and post-test (6.55±2.24) did not have a statistically significant difference (P=0.40).

In the serious game group, the average score of pre-tests (6.82±2.31) and post-test (8.73±2.34) had a statistically significant difference (P<0.001).

In the multimedia group, the average score of the pre-test (7.20±1.90) and post-test (8.33±2.53) had a statistically significant difference (P=0.002).

The usability is divided into 4 sub-groups of Aesthetics, Learnability, Operability and Accessibility. According to Table 1, there is significant difference in aesthetic, learnability and accessibility items of MEEGA questionnaire between serious game and multimedia case-based learning group. The player (student) experiences include 9 subsets of Confidence, Challenge, Satisfaction, Social Interaction (Table 2), Fun, Focused Attention, Relevance, Perceived Learning and User Error Protection (Table 3). According to table 2 and 3, there is significant difference in confidence, social interaction, fun, focused attention, relevance and perceived learning items of MEEGA questionnaire between serious game and multimedia case-based learning group.

Table 1: The results of the evaluation - usability of serious game and multimedia based on MEEGA[1] questionnaire by pharmacy students. (Game group N=50, multimedia group N=48)

Usability	*Statements*	*Intervention groups*	*Frequency of participants' comments (%)*			*P-value*[2]
			Disagree	*Neither disagree nor agree*	*Agree*	
Aesthetics	The educational intervention design is attractive	Game	12	26	62	0.008
		Multimedia	0	15	85	
	The text font and colors are well blended and consistent.	Game	8	22	70	0.067
		Multimedia	0	15	85	
Learnability	I needed to learn a few things before I could do the educational intervention.	Game	0	20	80	0.204
		Multimedia	2	31	67	
	Learning to do this educational intervention was easy for me.	Game	2	6	92	0.039
		Multimedia	0	20	80	
	I think that most students would learn to do this educational intervention very quickly	Game	0	14	86	0.153
		Multimedia	4	23	73	
Operability	I think that the educational intervention is easy to do	Game	**2**	16	82	0.657
		Multimedia	**2**	25	73	
	The educational intervention rules are clear and easy to understand.	Game	**2**	8	90	0.327
		Multimedia	6	14	80	
Accessibility	The fonts (size and style) used in the educational intervention are easy to read.	Game	4	10	86	0.490
		Multimedia	0	6	94	
	The colors used in the educational intervention are meaningful.	Game	16	40	44	0.046
		Multimedia	**2**	40	58	

1- MEEGA (Model for the Evaluation of Educational Games)

2- P-value <0.05 was considered as significant

Table 2: The results of the evaluation - user experience of serious game and multimedia based on MEEGA[1] questionnaire by pharmacy students. (Game group N=50, multimedia group N=48)

Player Experience	*Statements*	*Intervention groups*	*Frequency of participants' comments (%)*			*P-value*[2]
			Disagree	*Neither disagree nor agree*	*Agree*	
Confidence	The contents and structure helped me to become confident that I would learn with this intervention	Game	2	8	90	0.003
		Multimedia	2	33	65	
Challenge	This intervention is appropriately challenging for me	Game	0	30	70	0.158
		Multimedia	8	27	65	
	The intervention does not become monotonous as it progresses	Game	6	28	66	0.144
		Multimedia	0	21	79	
Satisfaction	Completing the intervention tasks gave me a satisfying feeling of accomplishment	Game	0	18	82	0.450
		Multimedia	0	13	87	
	It is due to my personal effort that I managed to advance in the intervention	Game	4	58	38	0.466
		Multimedia	10	53	37	
	I feel satisfied with the things that I learned from the intervention	Game	2	4	94	0.628
		Multimedia	2	11	87	
	I would recommend this intervention to my friends	Game	0	24	76	0.625
		Multimedia	2	19	79	
Social interaction	The intervention promotes cooperation and/or competition among the students	Game	18	36	46	0.195
		Multimedia	13	54	33	
	I felt good interacting with other students during the intervention	Game	24	28	48	0.018
		Multimedia	35	44	21	

1- MEEGA (Model for the Evaluation of Educational Games)
2- *P*-value <0.05 was considered as significant

Table 3: The results of the evaluation - user experience of serious game and multimedia based on MEEGA[1] questionnaire by pharmacy students. (Game group N=50, multimedia group N=48)

Player Experience (continued)	*Statements*	*Intervention groups*	*Frequency of participants' comments*			*P-value2*
			Disagree	*Neither disagree nor agree*	*Agree*	
Fun	I had fun with the intervention	Game	2	16	82	0.203
		Multimedia	11	18	71	
	Something happened during the intervention which made me smile	Game	18	20	62	<0.001
		Multimedia	45	32	23	
Focused attention	There was something interesting at the beginning of the intervention that captured my attention.	Game	8	26	66	0.219
		Multimedia	13	12	75	
	I was so involved in my task that I lost track of time	Game	14	30	56	0.033
		Multimedia	35	30	35	
	I forgot about my immediate surroundings while applying this intervention	Game	20	40	40	0.360
		Multimedia	31	40	29	
Relevance	The contents are relevant to my interests	Game	8	20	72	<0.001
		Multimedia	2	31	67	
	It is clear to me how the contents of the intervention are related to the course	Game	0	6	94	0.140
		Multimedia	2	15	83	
	This intervention is an adequate teaching method for this course	Game	24	42	34	0.046
		Multimedia	47	28	25	
	I prefer learning with this intervention to learning through other ways	Game	4	8	88	0.003
		Multimedia	19	23	58	
Perceived learning	The intervention contributed to my learning in this course	Game	0	4	96	0.513
		Multimedia	2	7	91	

Table 3: Continued…

	The intervention allowed for efficient learning compared with other activities in the course	Game	0	6	94	0.007
		Multimedia	2	26	72	
User error protection	The intervention prevents me from making mistakes	Game	18	38	44	0.001
		Multimedia	2	21	77	
	When I make a mistake, it is easy to recover from it quickly	Game	0	12	88	0.162
		Multimedia	6	7	87	

1- MEEGA (Model for the Evaluation of Educational Games)
2- *P*-value <0.05 was considered as significant

Discussion

Appropriate academic education of pharmacy students has been always of paramount importance, due to its profound reflection on public health and health equity (7, 21). Using active learning approaches has been proved to considerably influence the quality of learning and engagement of students (7). As an active teaching method, serious games tend to foster learning capabilities of students and reinforce their cognitive skills via exploiting of interactive tasks and delightful framework (22).

The current study with its inimitable attributes focused on the constructive effects of a new serious game called Pharm-PSY on pharmacy students' comprehension of psychology modules. Not only did it evaluate the new teaching approach of the educational serious game and compare it with the traditional lecture method, the game method was also correlated with the multimedia case-based learning technique, studied so far. Furthermore, in order to make a favorable comparison, the students' opinions regarding the two strategies (game and multimedia) were assessed using similar, validated and modified questionnaires adapted from the same source. Based on the literature review in this field, no study was found that compared the two methods of serious gaming and multimedia case-based learning with the similar tool.

For both educational interventions, the post-test scores were markedly higher than the pre-test scores, indicating that both methods successfully enhanced the knowledge level of pharmacy students. There are diverse sets of data regarding serious games investigations, which lead to a complicated correlation between studies; however, the positive effects of learning-through-play on the depth of knowledge acquisition have been revealed in numerous studies.

For instance, implementation of a serious game (InsuOnline) on diabetes mellitus in primary care physicians who participated in continuing education programs, could substantially improve the learning capabilities of participants by increasing the number of correct answers in the post surveys (92% right answers in the game players vs. 85% in conventional method arm, *P*<0.001) (23). Correspondingly, United Kingdom pharmacy students experienced a significant increase in their post test scores after playing a web-based prototype game (Pharmacy Challenge) based on the British National Formulary (BNF) (*P*<0.05). The number of correct answers was raised from the mean of 4.4 to 6.2 out of 8 possible marks. This improvement seemed to be the result of empowering students to use BNF with more confidence (24). The vast majority of research that is currently being carried out in the field of pharmaceutical training and education, corroborates the beneficial effects of interactive platforms, including escape rooms, simulated games and serious digital games on learning outcomes. In a recent study the merits of a simulated game on the toxicology course, of 22 pharmacy students who played the case study-based game of 2 cases, 18% passed the pretest of case 1 and 82% received the passing score in the post-game test. For case 2 none of the students could pass the pre-test, while 68% successfully passed the post-game exam (25). All of these findings are parallel to our results in terms of enhanced knowledge acquisition through engagement in challenging situations of game playing.

The results of the evaluation questionnaire demonstrated that playing the educational game was associated with a substantial enhancement in

students' confidence, perceived learning and focused attention in comparison to the multimedia case-based learning users. Moreover, the students who believed the game was relevant to the course subject vastly outnumbered the learners who had the same opinion about the multimedia platform. Furthermore, compared to the students in multimedia group, a considerable proportion of game players considered the game a fun learning platform which noticeably improved their social interactions. Many of our findings are corroborated by various types of previous studies pertaining to educational games.

Due to their appealing and engaging properties, serious games as pedagogically-driven platforms could successfully promote intensive learning such as medical education (26). For instance, social interactions of healthcare students were drastically improved through an online simulation game (SPENT) regarding perception of poverty (27). Korenoski et al. evaluated the pharmacy students' learning capabilities via a simulated toxicology game. The game players acquired extra confidence in management of intoxicated patients (25). A study in which thirty freshmen pharmacy students voluntarily participated in a jeopardy game revolving around neurology course showed that all the students were fully satisfied and the learning process was faster and more desirable through playing the game (28). A serious game was designed on the mobile platform. The purpose of this study was to promote the participation and learning of pharmacy students in the management course. Similar to the results of our study, the game (Planet Finance) and its instructions were easy to play, and fun, increased engagement and perceptions of the content (6).

One of the distinctive features of this study is that it is the first research that was conducted on pharmacotherapy of common psychiatric disorders for pharmacy students. The only study with a suitable sample size that has so far compared two active teaching methods (serious game and multimedia case-based learning) with each other and with the traditional lecture method.

One of the special features of this research was the use of similar questionnaires to compare the two active teaching methods as well as possible. Among the limitations of this study was the evaluation of the students' opinions of one entry and the only one university. Moreover, just one of the topics of pharmacotherapy was investigated. Considering the diverse methods of designing and evaluating serious games, in order to improve the quality of studies, there is a need for valid and uniform evaluation tools. It is better to investigate such studies on other medical students in addition to pharmacy students. Funding and increasing interdisciplinary collaboration will help improve the quality of serious game development.

Conclusion

Scores difference showed that the educational interventions were able to improve student's knowledge and skills. In the sections of Confidence, Social Interactions, Fun, Focused attention, Learnability, Relevance, and Perceived Learning, the serious game far outweighed the multimedia case-based learning. In spite of the limited investigations that have been conducted on the use of serious games in the field of pharmacy students' education, the results of these studies have been promising and positive. Using serious game provides a safe and stress-free environment for practicing, so it improves self-confidence, concentration and knowledge retention. Applying game makes the education process more enjoyable, and motivates students. Social interaction promotion and receiving immediate feedback may lead to attitude change. All of these parameters prepare pharmacy students as the healthcare provider for real life situations so they can better help patients and promote public health.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or fal-

sification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This paper and the research behind it would not have been possible without the exceptional support of supervisors. The authors would like to acknowledge all supervisors and pharmacy students who participated in the project. This study was supported by Research Center for Rational Use of Drugs, Tehran University of Medical Sciences and National center for strategic Research in medical education.

Conflict of interest

The authors declare that there is no conflict of interests.

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