Journal of Pharmaceutical Care & Health Systems
ISSN: 2376-0419

Shawaqfeh, J Pharma Care Health Sys 2015, S2
DOI: 10.4172/jpchs.S2-004

Commentary Open Access

Gamification as a Learning Method in Pharmacy Education

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Abstract

Background: Collaborative learning through gamification can assist students in developing knowledge building and interpersonal skills, as well as help improve comprehension and confidence. Various studies have shown that incorporating games into healthcare education can be beneficial and enhance students' engagement in learning.

Objective: To conduct a systematic review, in order to determine the effects of implementing educational games into the pharmacy curriculum.

Methods: We performed a systematic review through the Embase and Mendeley databases, limiting our search terms to pharmacy, education and games. Studies included students from various healthcare professions, such as pharmacy, medical, nursing and psychology fields. We then categorized our findings based on the different types of educational games to assess the potential benefits in implementing these strategies into pharmacy education.

Results: We preselected a total of 50 articles, separated 15 duplicates, and then analyzed 11 articles, which were full-text articles relevant to the topic.

Conclusion: Gamification in healthcare education can improve and evaluate the integration of knowledge, comprehension and confidence. Although some students believed that the games did not affect their overall grades, the majority of the students felt they were more engaged and had more preparedness and confidence for real life scenarios as a result of participating in the different educational games.

Keywords: Gamification; Pharmacy education

Introduction

Gamification can be defined as the process of adding games or game elements into something in order to encourage participation (Webster). Although the notion of learning subjects such as physiology or pharmacokinetics by playing games seems inane, it has actually been proven to help develop the skills of healthcare professionals and improve their overall confidence. Traditional lectures focus of delivering a particular topic to students with the goal of having the students then being able to apply the information in a clinical setting. The application of the material taught during school includes much more than just learning the material. It includes being able to use decision making and critical thinking skills, and being able to communicate properly both with patients and other healthcare professionals. The idea of gamification provides an additional opportunity to practice these skills by utilizing classroom time to practice applying their knowledge. These games function much like laboratory classes do, in a sense that they implement more of hands on technique and help students see how what they are taught is applied in different settings. At the University of North Carolina Pharmacy School, a study was conducted to see the effects of adding games to traditional lectures. The games were used to motivate and engage students while reinforcing previously taught material, to teach new concepts or introduce new ideas. The overall goal was that students would be able to apply the pharmacokinetic principles learned in class to different experiences that may be encountered by community or institutional pharmacist, by applying interactive group work rather than just memorization. The study assessed student's perception of the games and concluded that most students found the games to be enjoyable and a helpful tool for gaining confidence and exposing the students to real life experiences; however, the study was inconclusive in regards to whether it helped the students increase their grades [1]. This concept is being implemented not only in pharmacy schools, but also in a variety of educational setting from a range of different educational levels. The main focus of our study was to evaluate the impact that gamification may have if implemented into pharmacy classroom education. In order to do so, we conducted a systematic review to evaluate the effects of implementing gamification in the classroom setting of various healthcare professions, and to what extent it improved student's overall performance.

Methods

We performed a systematic review through the Embase and Mendeley databases, using the search terms pharmacy, education and games. The inclusion criteria were studies that dealt with health professionals, studies that implemented gamification as a learning tool, as well as English and full text articles. Studies were excluded if they were not English or healthcare and gamification related, or if we were unable to obtain the full-text article. The different types of participants included were those who were in various healthcare professions, such as pharmacy, medical, nursing and psychology fields. The different studies ranged from prospective randomized trials to interventions that conducted surveys before and after the trials. We collected 11 full text articles that we then categorized based on the different types of educational games implemented. The categories used were digital games, card/board games, quiz shows and simulation games. Out of the 11 articles, one article was categorized as digital games, which had an experimental group play video games on the Nintendo Wii and a control group was instructed not to. Two articles were sorted under card/board games; these studies used battle of the sexes, operation,

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Received February 23, 2015; **Accepted** March 11, 2015; **Published** March 20, 2015

Citation: Shawaqfeh MS (2015) Gamification as a Learning Method in Pharmacy Education. J Pharma Care Health Sys S2-004. doi:10.4172/jpchs.S2-004

concept mapping and card games as their game formats. Under the quiz show category, one article implemented games such as Jeopardy and Hollywood squares as its learning design. The last category was simulation games, which included two studies. One study used patient-stimulation mannequins to teach the pharmacotherapuetics course [2], and the other study used pros and con argument simulations, for example Moral Education vs. Discipline Policies. The outcome of interest in this systematic review is to assess the potential benefits (i.e. comprehending, confidence, gaining knowledge, collaborating and deviating from rote memorization) in implementing these strategies in pharmacy education.

Results

Figure 1 shows the study flow. We searched Embase and Mendeley databases and identified a great number of citations. We screened the title and abstract of these citations and preselected a total of 50 potentially eligible articles, 15 of which were later found to be duplicates.

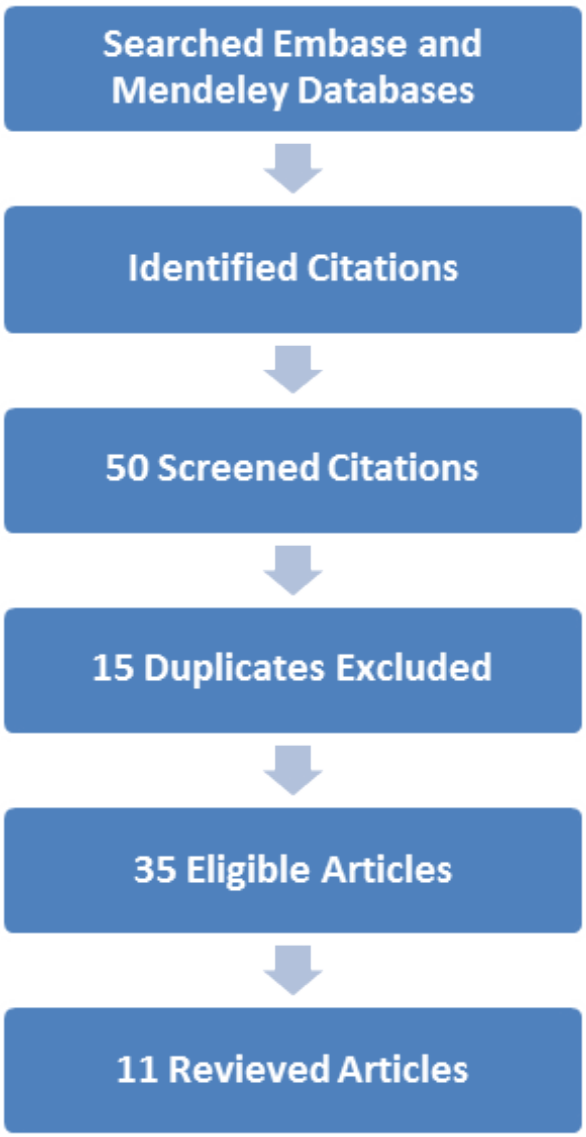

Figure 1: Study Flow.

From the remaining 35 preselected articles, we evaluated and selected 11 articles to be further analyzed, which were full-text articles mostly relevant to the topic.

Overview of the studies included in the review

Table 1 then represents a brief summary of all 11 studies included in this review. Participants in these studies were students from various healthcare professions, such as pharmacy, medical, nursing and psychology fields. We decided to include mostly pharmacy student's studies because there is no prior review specifically designed to indicate the effect of educational games on this group of interest. None of the studies assessed exactly the same game, but we were able to group them into similar categories, as previously described in the methods. The type of interactive games assessed were concept mapping [3] card games [4], simulation [2,5], Nintendo® WiiTM training [6], different TV shows [7,8], crossword puzzles [9] classic board games [10], and other innovative learning tools [11].

In the Hill's study, concept mapping was incorporated into an existing course to evaluate if retention of pharmacy communications information would improve. Although the implementation of this concept required a significant investment from instructors, students were able to grasp conceptual meanings, raising learning above simple memorization. Cardiology and infectious diseases students enrolled in an advanced pharmacy practice experience (APPE) learned about two card games, Cardiology Go Fish and Infectious Diseases Gin Rummy for the Barclay et al. study. When compared to previous scores for pharmacy practice questions, their assessment scores improved significantly, 19.2% vs. 5.1%, ($p < 0.001$) and 10.3% vs. 5.1% ($p = 0.006$), respectively.

All 42 participants in the Giannotti et al. study improved significantly from session 1 to session 2 in both groups (controls, no training with the Nintendo® WiiTM group versus training with the Nintendo® WiiTM group). The Wii group showed a significant improvement in performance ($p<0.05$) for 13 of the 16 considered performance metrics when compared against the control group. In another study, The Auman study, changes from pretest to posttest results indicates that, even though equivalent learning occurred across classes, simulation classes reported higher levels of classroom engagement. In general, although these studies varied in terms of design and types of interactive games assessed, the results were very similar with all the students' benefiting, to some extent, from applying the gamification methods.

Discussion

A systematic literature review was done and a total of 11 full text articles were collected and evaluated on gamification and healthcare education. There was only one randomized controlled trial (RCT) found, which separated participants into two distinct groups. Group one consisted of 21 surgical resident students who played video games with the Nintendo Wii console, and the other 21 surgical resident students were instructed not to. This lasted a total of 4 weeks [6]. In another study, 45 advanced pharmacy practice experience (APPE) students participated in two card games, Cardiology Go Fish and Infectious Disease Gin Rummy. A questionnaire was given as a pre-assessment to the students prior to the study as a control. In this questionnaire, 30 questions addressed cardiology, 30 questions addressed infectious disease and the remaining 30 questions addressed general pharmacy practice questions. After a 6 week period of playing games, the questionnaire was given again in addition to a survey consisting of 23 multiple choice and open-ended questions. The latter, was to gain

Study	Objective/ Intervention	Participants	Design	Assessment	Results	Conclusion
Concept mapping in a pharmacy communications course to encourage meaningful student learning Hill (2004)	To develop a concept map to improve retention and comprehension rather than just memorizing material.	109 students from a pharmacy communications course in the fall 2002 term.	Students in small groups (3 to 5 people) created a mutual concept map that demonstrated their understanding of three main concepts and the connection between them and the coursework material.	Student assessment focused on the understanding of the students of the material taught. A scoring rubric was used that included concepts, hierarchy, cross-links and examples to assess their understanding and thinking process.	There were both positive and negative comments about the concept mapping. Some felt that it helped them understand better and some said they were not visual learners and it didn't suit their learning.	Concept mapping requires a lot of effort and time from both the instructors and the students. The reward for faculty members is that students learn to understand abstract material and be challenged to move beyond rote memorization to meaningful learning.
Educational card games to teach pharmacotherapeutics in an advanced pharmacy practice experience Barclay et al. (2011)	Card games to help teach pharmacotherapeutics and establish a relationship between students' assessment scores and their learning styles.	Pharmacy students enrolled in an advanced pharmacy practice experience (APPE) (45 participants)	Different card games: Two card games, Cardiology Go Fish and Infectious Diseases Gin Rummy.). Students were required to play each game for 1 hour, 3 times over a 6-week period.	Forty-five students completed a 90-question assessment administered prior to and after the 6-week period in which the games were played.	Students' cardiology and infectious diseases assessment scores improved. Students learned from participating in the games regardless of their learning preference as determined by the VARK (visual, aural, read/write, kinesthetic) questionnaire;	Incorporating innovative learning tools such as card games into the curriculum of APPEs can enhance the educational experience of pharmacy students.
Multi-faceted approach to improve learning in pharmacokinetics. Persky (2008)	To integrate a series of educational strategies to enhance learning of pharmacokinetics.	Pharmacy students from basic and clinical pharmacokinetics courses	Games, a piloted multimedia module to offset content delivery and free-up class time, reflective writing, and an immediate feedback assessment were applied to basic and clinical pharmacokinetics courses	An assessment tool to provide immediate feedback and score comparisons.	Median examination scores did not improve following the incorporation of the teaching innovations; however, based on survey results, student satisfaction increased.	The effectiveness of the innovations implemented may be more accurately measured over the long term, eg, in performance in advanced pharmacy practice experiences.
Pharmacy student response to patient-simulation mannequins to teach performance-based pharmacotherapeutics Seybert at al. (2006)	Simulated patient-case assessment using a mannequin for critical care pharmacotherapeutic class, and evaluate student satisfaction with the simulation.	Second year doctor of pharmacy students from a Introduction to Critical Care course (98 participants)	Patient information was programmed into a simulation mannequin, which demonstrated characteristics of a critically ill human.	Students were surveyed post-simulation to determine the effectiveness of the learning experience.	The majority of students (88%) were extremely satisfied with the experience. The facilitator was considered to be extremely useful in 75% of responses.	By involving students in actual patient cases early in the pharmacy curriculum, this type of education could produce pharmacists with a high level of expertise and confidence.
Play to Become a Surgeon: Impact of Nintendo WII Training on Laparoscopic Skills Giannotti et al. (2013)	To assess if video gaming (Nintendo Wii) can benefit enhancement of spatial attention and eye-hand coordination in laparoscopic procedures.	Post-graduate I-II year residents in General, Vascular and Endoscopic Surgery (42 participants)	A four-week trial was done and structured Nintendo® Wii™ training on laparoscopic skills by analyzing performance metrics with a validated simulator (Lap Mentor™, Simbionix™).	A prospective randomized study on 42 post-graduate I-II year residents was designed.	All 42 subjects in both groups improved significantly from session 1 to session 2. Compared to controls, the Wii group showed a significant improvement in performance ($p<0.05$) for 13 of the 16 considered performance metrics.	The Nintendo® Wii™ might be helpful, inexpensive and entertaining part of the training of young laparoscopists. The Nintendo Wii may be adopted in institutions that have low budget and can help to optimize training before doing real procedures in the operating room.
Popular game shows as educational tools in the pharmacy classroom Chavez at al. (2012)	Assess the effectiveness of using popular television game shows for the purpose of learning or reviewing material	Pharmacy students	Adaptation of three game shows (the Price is Right, Family Feud, and $100,000 Pyramid) in a large pharmacotherapeutics class, and a board examination review session consisting of small groups.	N/A	N/A	The game shows were well received by the students, however the study was inconclusive due to lack assessment tools used.

Study	Objective/ Intervention	Participants	Design	Assessment	Results	Conclusion
Student attitudes toward the use of games to promote learning in the large classroom setting Grady et al. (2013)	Determining student attitudes towards the use of games to introduce new material, review old material or as the sole teaching method	Pharmacy students	Different games were utilized as a component of three of nine lectures in an advanced psychiatric pharmacy elective course.	A survey was administered during the final course session.	The majority of the students agreed that games were an effective way to promote learning when introducing and reviewing a topic. However, students indicated that they learn more from a traditional lecture versus a game format.	Using games as an adjunct to traditional lecture in the large classroom setting may be effective when introducing or reviewing a subject.
Students perceptions of the incorporation of games into classroom instruction for basic and clinical pharmacokinetics Persky et al. (2007)	To develop classroom games as alternatives to traditional pharmacokinetic instruction.	Students from a basic and clinical pharmacokinetics course	Classroom games were created for simple semester review, application of pharmacokinetics in a community-pharmacy setting, and development of critical thinking skills and concept application. All the games incorporated some degree of group activity.	A survey was conducted of students' attitudes towards the incorporation of games into the classroom, as well as comparing final examination scores to scores from the previous yea.	Overall, students found the games enjoyable, but some students questioned how much they learned.	Although the games appeared to have a positive impact on grades and incorporated more than just factual, book knowledge (eg, critical thinking skills), determining how these games improved learning will require further assessment.
The use of crosswords puzzles as an innovative teaching method for clinical pharmacy Leon-Gonzalez et al. (2011)	To see the practically of using the crossword puzzle as an interactive teaching method in final year pharmacy students	Students of Pharmacy Degree at the University of Seville from a clinical pharmacy class	Teachers developed nine different crosswords containing 20 definitions related to various topics of clinical pharmacy and were administered to the student to solve at the same time.	Participant students were evaluated according to the number of solving definitions at the moment that the first student group finished solving the crossword. feedback was taken from the student regarding to the use of this innovative approach.	Working students enjoyed the competitions among their classmates, the full autonomy in solving the crosswords and learned new concepts in clinical pharmacy. Many students found that solving academic crosswords is a unique experience and it helps promoting generic learning skills.	This model actively engaged the student in the learning process and represents an interesting way for student to learn course material generating enthusiasm and stimulating thought processes focused on the study of clinical Pharmacy.
Using game format in small group classes for pharmacotherapeutics case studies Patel (2008)	To incorporate games in classroom teaching to encourage student interest and participation in a small group pharmacy therapeutics case studies class.	Students from a Pharmacotherapeutics case studies class (8 classes, 16 participants in each class).	Using a television quiz show and classic board game format, students and the instructor developed games to discuss patient care plans.	At the end of the course, a questionnaire was administered to assess students' attitudes and perception of using game format in the class and whether this teaching method was useful in reinforcing therapeutic knowledge.	The majority of the students felt that games were beneficial in their learning process. The game format also resulted in higher student participation scores.	The game-format approach to learning aroused student interest, enhanced participation, and improved their participation grades.
Using Stimulation Games to Increase Student and Instructor Engagement Auman (2011)	To use simulation-based games to increase student and instructor engagement. .	Students from a Educational Psychology course (129 participants)	Student learning was examined throughout simulation and non-simulation classes.	The costs and benefits of switching practice of teaching were examined. Differences in learning and engagement were also assessed.	Changes from pretest to posttest results indicated that equivalent learning occurred across classes, with simulation classes reporting high levels of classroom engagement.	The benefits of switching practice of teaching outweigh the costs. Student learning is not diminished and engagement is increased and found to be beneficial for both student and instructor

Table 1: Study.

feedback in regards to their experience. A VARK questionnaire was also distributed to all students in order to assess the students learning preference which included visual, aural, read/write, and kinetic.

The results of the studies analyzed for our systematic review indicate that there are a wide variety of different game formats that can be incorporated into pharmacy teaching curriculums. The response of students from the majority of the studies imply that there is a great benefit in critical thinking skills and classroom engagement gained from implementing gamification into their curriculums. As stated before, it is important for students to not only be able to understand different topics, but also be able to apply and communicate their knowledge. As was seen with many of the studies analyzed, gamification may provide a tool to be able achieve this. Some of the main points emphasized by the majority

of the students in the studies are that they found the games enjoyable, that they felt more confident about applying their knowledge in real life and that they were more engaged during classroom discussions. Many of the students did not feel like gamification actually improved their grades, however, we believe that the duration of the study should be longer in order to determine if there is any potential benefit and improvement in student grades, at least one semester as per the Hill's study. More time is needed to best incorporate the gamification into the curriculum and for students to assimilate the material. We also believe that the number of participants in most of the studies should have been higher, and lack of randomized control trials based on gamification makes it difficult to assess whether or not gamification has the potential to improve student grades. Although examinations and grades are an important means to assess comprehension and proficiency, we believe that other characteristics such as critical thinking, communication skills and overall confidence are just as important and are often difficult to assess in students. Based on the studies analyzed, Gamification could be used to assist students in developing and evaluating these crucial characteristics.

Conclusion

Based on our analysis of the 11 articles pertaining to gamification, we can conclude that incorporating different styles of games into the pharmacy curriculum may aide students in preparing for real life experiences, by exposing them to different scenarios that may be encountered, and allowing them to improve their critical thinking and communications skills to better handle these scenarios. From the instructor's perspective, although the process of developing games to be applied into a curriculum can be time consuming to say the least, the outcomes can be very invigorating. We also believe future studies related gamification could examine if educational games could potentially be used to not only help students to learn and engage better, but also enhances communication and bonding amongst students from different backgrounds who sometimes do not interact with each other. Overall, we believe that the implementation of gamification into pharmacy curriculum, as it has been done for other health care disciplines, can enhance student's learning as well as classroom engagement.

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