



Digital games in health professions education: Advantages, disadvantages, and game engagement factors

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Received: 3 Apr 2016

Published: 22 Dec 2017

Abstract

Background: The application of digital educational games in health professions education is on expansion and game-based education usage is increasing.

Methods: Diverse databases were searched and the related papers were reviewed.

Results: Considering the growing popularity of educational games in medical education, we attempted to classify their benefits, flaws, and engaging factors.

Conclusion: Advantages, disadvantages, and engagement factors of educational digital games used for health professions education must be the focus of attention in designing games for health professions discipline.

Keywords: Game, Advantages, Disadvantages, Game engagement factors, Health professions education

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Cite this article as: Bigdeli Sh, Kaufman D. Digital games in health professions education: Advantages, disadvantages, and game engagement factors. *Med J Islam Repub Iran.* 2017 (22 Dec);31:117. <https://doi.org/10.14196/mjiri.31.117>

Introduction

It is commonly acknowledged that a digital game can serve as a medium to promote health professions and provide an opportunity for interdisciplinary education. In particular, the essential elements of games (1-3) and game attributes of the player/players, conflicts, rules, predetermined goals of the game, the artificial (4) and the pedagogic nature of games (5) are extensively described in the literature.

Despite the increasing popularity of digital games, the emphasis on their positive educational advantages over traditional teaching methods (5-7) and the opportunities provided for diverse preferred learning styles of learners (8), to the best of our knowledge, the findings on pedagogical applications are not conclusive in the literature. In health professions education, digital games are acknowledged as games, simulations, simulated games, virtual environments, social and cooperative plays, and alternative reality

games (5, 6, 9); however, there are some differences, but common advantages, disadvantages, and engaging factors involved.

Moreover, extensive research has been conducted on the application of digital games, but few provide a comprehensive classification based on advantages and disadvantages of games and their engaging factors. In this regard, this review study is a synopsis of the auspicious area of digital gaming, which explains its potential benefits, flaws, and engagement factors for introducing gamification as a medium to promote health professions education. This study is focused on digital games used in medicine, nursing, pharmacy, and dentistry education during 2010 to 2015, while other disciplines of health professions education were not the focus of concern.

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↑What is “already known” in this topic:

The application of digital educational games is increasing in medical and health professions education.

→What this article adds:

Under the game conditions, stress-related physiological experience (eustress or distress) of digital game players are similar to the signs and symptoms of stress in other situations. Advantages of digital educational games can be categorized as learning process enhancer, learning and performance improver, and individualized learning provider. Disadvantages of digital educational games can be categorized into teaching-learning process barriers and logistics of educational games.

Methods

This review study was conducted from September to December 2015 by reviewing peer-reviewed journal articles published in, CINAHL Complete, Cochrane Library (Cochrane CENTRAL and Cochrane Reviews), EBSCOhost, Elsevier Science Direct, ERIC, PsycINFO, PsycARTICLES, PubMed, PubMed Central (PMC), and PubMed/MEDLINE databases with the following search terms (AND, OR, NOT) and keywords: Game, gamified, gamification, computer game, digital game, electronic game, video game, systematic review, meta-analysis, meta-analysis, health professions, medical, nursing, pharmacy, dentistry, education, advantages, benefits, disadvantages, flaws, and game engagement factors.

Inclusion criteria

Articles related to games were filtered and limited to full-text peer-reviewed papers in English published during 2010 and 2015. It was also decided to include studies in which health professions learners were study participants, and in which digital games in health professions education disciplines of medicine, nursing, pharmacy and dentistry were addressed.

Titles and abstracts, resulting from the initial online search with the selected MeSH and free text terms related to digital educational games were screened for relevance

and eligibility for full text retrieval. The researchers searched additional articles through citation by manual checking of the reference sections of the sourced articles. The researchers resolved their disagreements by discussion. Finally, articles focusing on the use of specific educational games for health professions education disciplines of medicine, nursing, pharmacy and dentistry were retrieved.

Exclusion Criteria

The articles were excluded under the following conditions, not available in full text; if the participants were residency learners and/or health professionals only (e.g., surgeons, specialists, etc.); patients, teachers and/or staff only; the studies addressing blogs, discussion boards, podcasts, videos and videoconferencing; non-digital games; the studies on apps for smart phones, tablets, and portable music players; the studies on topics of patient management, patient education, teacher and staff education.

Results

According to the findings of the study, advantages and disadvantages of games have been the topic of dispute (7, 8, 10-26). Further, an educational game as an engaging, competitive, motivating, and pleasurable activity with specified sets of rules and regulations and other common elements of feedback, challenge, and interaction promotes

Table 1. Digital educational game advantages for teaching and learning in health professions education

Game as a teaching tool	
Improves cognitive, affective, and psychomotor knowledge and skills acquisition	[10, 11]
Provides an extra-curricular learning opportunity	[12]
Provides repetitive learning experience	[13, 14, 15, 16]
Provides an effective teaching strategy [tool] feasible for adult learners	[11, 17]
Positively enhances teaching-learning process	[18]
Reinforces knowledge acquisition	[18]
Provides an opportunity for instructors to discuss and present instructions	[8, 17, 19]
Provides immediate feedback	[7, 8, 11, 12, 15, 19-23]
Allows learners to enrich their knowledge implicitly	[11]
Provides a stealth mode of teaching	[24]
Is a valuable method for teaching abstract concepts	[25]
Goes beyond a basic core curriculum	[26]
Customizes educational content to differentiate by pace and mode [e.g., visual versus aural] of learning	
Expedites in-depth study of chosen fields	[26]
Provides an opportunity for mutual engagement of learners and teachers to share ideas and work collaboratively	[26]
Learning enhancer and performance promoter	
Provides a context for recall	[15, 17]
Provides learner autonomy and independence	[27]
Provides an opportunity for clinical practice	[28]
Provides an opportunity for instructors to clarify misconceptions	[8]
Puts a positive impact on assessment	[18]
Reinforces learning objectives	[19, 28, 29]
Brings about Social and emotional development	[30]
Improves clinical learning behavior	[31]
Bridges theory and practice	[6, 17,28]
Improves doctor-patient relationship	[26]
Improves leadership, prioritization and resolution	[35]
Provides an opportunity for trial and error exploratory learning	[11]
Involves one's eyes, ears, touch, and mind	[11]
Is appealing to learners with diverse learning styles [e.g. visual, auditory, and kinesthetic] aligned with learners' preferred learning styles	[11, 19]
Is learner based / learner-centered	[13, 28]
Increases enthusiasm and interest:	[8, 28, 32]
• in learning and/or	
• in the subject content	
Is customizable to the needs of individuals and groups	[10, 14]

Table 1. Cntd

Provides a novel opportunity for the learners to:	[11]
<ul style="list-style-type: none"> Contextualize information and Study the consequences of their choices 	
Practical benefits Provider	
Provides an outcome or goal oriented opportunity	[6, 20]
Provides structured and ruled context activity	[7, 9, 21, 29]
Provides a reward system	[17, 23]
Includes briefing and debriefing	[23]
Improves knowledge retention	[32]
Is cheaper than traditional teaching methods	[24]
Enhances learning and teamwork	[32]
Improves problem-solving	[11, 19, 28, 29]
Enhances stress management	[33]
Motivation/ Interest Enhancer	
Provides a learning variety	[6]
Leads to positive emotions and emotional stability	[27,34]
Helps better attachment to educational settings	[34]
Holds learner-oriented/ or centered approach	[6,24, 29]

teaching and learning. A digital educational game has several advantages; for example, as a teaching tool, it is feasible for adult learning, and provides an opportunity for experiential repetitive learning. Furthermore, engaging learners enhances the acquisition of knowledge, attitude, and practice, allows learner individualization, improves learning process and learning outcomes, and provides practical benefits for teachers, learners, and health system target audience. Application of digital educational games provides a safe virtual curricular and extracurricular educational space beyond ordinary teaching and learning contexts for more collaboration between teachers and learners. Moreover, if digital games are adopted successfully they could improve patient-practitioner relationship (Table 1).

In contrast, the literature we reviewed has depicted a number of disadvantages for using digital games in a teaching and learning process; however, most of these disadvantages are only mentioned in one citation. Due to their competitive nature and production expensiveness, games are reported to be threatening and intimidating for some learners. Interdisciplinary expert dependency, time-consuming nature, and learning style dependency were other disadvantages mentioned in the literature. Other disadvantages, although important, were mentioned only once or

twice. These were boredom potential, lack of widely accepted guidelines, learners' lack of desire to cooperate leading to game failure, and potential negative reaction of learners to the game design, and thereby requiring teacher and student training (Table 2).

The aforementioned factors all fall under 2 major subcategories of disadvantages; the first one denotes the logistics of developing a digital game; i.e., interdisciplinary expert and participant dependency, lack of widely accepted guidelines, required training, and most importantly cost, and time. The second subcategory includes factors related to teaching and learning processes such as threatening and intimidating, learning style dependency, boredom potential, and negative reaction of learners to the game.

In addition to the above-mentioned disadvantages, our own game experience indicates that the potential of physical harm to game players is highly critical. Physical posture of the player during the gameplay and sitting stand still for a long period of time will jeopardize musculoskeletal health of the players. Moreover, digital game players experience physiological changes related to stress (eustress or distress) under the game conditions, which are similar to signs and symptoms of stress in other situations; e.g. muscular ten-

Table 2. Digital game disadvantages for teaching and learning in health professions education

Teaching-learning process barrier	
Threatening and intimidating competitive nature of games for some learners	[30, 8, 28, 17]
Anxiety and embarrassment potential for some learners	[17]
Mismatch of learning styles of some learners	[32, 35]
Boredom potential in poorly doers leads to demotivation	
Content seriousness leads to loss of gaming characteristics, enjoyment and motivational capacity, and consequent boredom	[7]
Learners lack of cooperation will lead to game failure	[35]
Potential negative reaction of learners to the game design	[8]
Time-consuming nature of games [e.g., length of time needed to develop updated and relevant scenarios and to design or set up a game]	[8,32]
Fund-consuming or expensiveness	[7, 27,35,36]
Lack of widely accepted guidelines on how to:	[7]
<ul style="list-style-type: none"> Teach with games effectively Implement large quantities of educational material as gaming content 	
Interdisciplinary-expert dependency of games requires collaboration of domain experts and game experts to develop learning materials	[7,36]
Requires teacher training	[35]
Requires student training	

Table 3. Educational game engagement factors: Learner-dependent

Cognitive Skills	
Attention [focus]	[6, 33]
Parallel	[11]
Visual	[33, 34]
Thinking	
Critical	[6, 8, 10, 16, 17, 28, 30, 35, 42]
Creative	[21, 35]
Positive	[21]
Strategic	[11, 34]
Reflective	[43]
Interpretive analysis	[11]
Reasoning	[8, 10, 33, 35]
Decision-making	[6, 8, 44]
Problem-solving	[10, 19, 20, 21, 34, 36]
Mental challenge	[6, 11, 13, 15, 22, 29, 36]
Intrigue/ curiosity	[21, 36]
Knowledge reinforcement	[17]
Active learning	[7, 8, 15, 16, 28, 35]
Deep learning	[8]
Planning	
Spatial creativity	[33]
Meta cognition	[10]
Affective Skills	
Participation	[9, 8, 12, 6, 22]
Motivation	[6, 7, 11, 12, 15, 20, 23, 32-34, 36]
Absorption	[6, 7, 8, 11, 16, 20, 22, 24, 32]
Enjoyment	
Fun to play	
Psychomotor Skills	
Improved technical skills for procedures	[22]
Interaction Skills	
Peer learning	[6]
Social interaction [fabric], communication, and networking	[6, 7, 8, 11, 12, 15, 17, 20, 21, 22, 26, 28, 29, 30, 35, 36, 43]
Collaborative, cooperative, and interactive learning	[13, 6, 30, 43, 20, 22, 26, 21, 8, 15, 29, 28, 11, 35]
Competition [team and individual/ self-directed]	[6, 20, 12, 30, 36, 22, 15, 7, 17]
Self- and team- efficacy	[43]
Psychosocial functioning	
Self-confidence	
Happiness	
Relaxation	[33]
Achievement motivation	
Empathy	

sion, dry mouth, clinging of fingers, pressure on jaws, palpitation, etc. (37). Moreover, in some cases, psychological game-dependency of game players is similar to internet addiction and individual game play limits social interaction and encourages individualism and isolation. Furthermore, the philosophy of gameplay is not a matter of discussion in designing educational games. In cases that the game character experiences emotions (e.g. pain, difficulty, pressure, anxiety, etc.), the vibes permeate to the player and s/he experiences the same emotional status; in other words, the

gameplay emotion is transferred to the player due to identification of educational game player and game characters.

Digital educational games by recruiting learner engagement factors (Table 3) and increasing energy level of players (6) positively influence cognitive, affective, and psychomotor skills of learners and actively engage them in the learning process (11-13, 15, 19, 22, 27, 28, 32, 33, 36). In addition, digital educational games, by improving visual memory/processing (33) and higher level thinking (38) of the game players, reinforce their analysis, synthesis, and evaluation competencies (39), reframe their identities and

Table 4. Educational game engagement factors: Game dependent

Game safety	
Safe learning environment	[25, 10, 17]
Chance [uncertainty, surprise, risk, and randomness]	[6]
Pride in achievement or accomplishment	[6]
Prize [reward]	[6, 23, 11, 33]
Humor	[6, 36, 35]
Surprise	[6]
Excitement	[32, 22]
Fun	[24, 6, 22, 8, 7, 22, 32, 35]
Fantasy	[6]

interests to their professional community of practice (40), and help them develop empathy (33) ethical and professional understanding of action and interaction in medical settings (40) or health profession communities. Digital educational games can be customized according to the pace and mode of learning in each individual (25), and since the medical curriculum could not be prescribed with the same magnitude for each learner (41), their application is a vehicle leading to a unique learning experience. Accordingly, based on the existing literature, we divided the game engagement factors to learner-dependent (Table 3) and game-dependent (Table 4).

Providing a safe educational environment is a promise of educational games for health professions education. It permits practice of what is really impossible or undesirable in real time and in a virtual world (16). Moreover, an educational game for health professions education positively enhances teaching and learning process and is to the benefit of students with diverse learning styles (e.g. visual and aural, read/write, and kinesthetic) (45).

Conclusion

This paper is a comprehensive review of the existing literature on digital educational games, with a specific focus on health professions education, addressing specific aspects of digital educational games including game advantages, disadvantages, and engagement factors. The findings of this study suggest that as a teaching tool, advantages of digital educational games can be categorized as learning process enhancers, learning and performance improver, and individualized learning provider, holding practical benefits and learners' motives. However, disadvantages of digital educational games can be categorized into teaching-learning process barriers and logistics of educational games. Finally, it is recommended that psycho-physio-philosophical aspects of learning be considered in digital game play contexts in another study.

Study strengths and weaknesses

The major strengths of this review study include a comprehensive search strategy, duplicate and independent screening of papers according to the titles and abstracts, retrieval and review of the full texts of all potentially eligible papers related to digital games in medicine, nursing, dentistry, and pharmacy published in English language. Moreover, classification of digital educational games based on advantages and disadvantages of using digital educational games in the teaching and learning process focused on health professions education and game engagement factors are other strong points of this study.

The weaknesses of the study were related to the limited scope of the review as the papers were reviewed during 2010 and 2015. Moreover, the conclusions do apply to types of interventions, sometimes labelled as games, such as role play, simulations, and serious games because their margins are blurred and to the best of our knowledge there is no clear cut-off point to discriminate them.

Even though rigorous attempts were made to ensure the audience that this review covered all articles on educational

digital games in the given disciplines, some papers might have been missed. Nevertheless, this limitation does not influence the frequency of advantages and disadvantages of digital educational games reported in the literature.

Finally, it is suggested that a team of curriculum designers, educational psychologists, cognitive psychologists, educational philosophers, physiologists, technical game designers, and content and game experts work together to develop an educational game in health professions education.

Acknowledgements

Funding of this paper was provided by AGE-WELL National Centre of Excellence (Project WP4.2)

Conflict of Interests

The authors declare that they have no competing interests.

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