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From Boring to Board Game: The Effect of a Serious Game on Key Learning Outcomes

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Abstract

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Keywords

Serious games, game-based learning, learning outcomes, motivation, active learning, experiential learning, social learning

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ABSTRACT

Serious games incorporate learning objectives in the context of competitive games with rules. These types of games have been incorporated in education as well as therapeutic contexts. This study examined the effectiveness of a modification of the game “Snakes and Ladders,” for reviewing and learning qualitative research concepts. Using the Game-based Evaluation Model (GEM), the researchers also measured learning indicators such as interest and enjoyment, perceived competence, effort and importance, and value/usefulness. Thirty-eight Master of Occupational Therapy students completed a 25-question multiple choice pretest to measure knowledge of qualitative research concepts before playing the game. A 25-question multiple choice posttest was administered five days later to measure the students’ knowledge retention. A seven-point Likert-type Learning Indicators Questionnaire (LIQ) based on the Intrinsic Motivation Inventory was also administered following the posttest. A dependent *t*-test revealed a statistically significant increase in mean scores on the posttest [$t(37) = 4.86$, $p < .001$; medium to large effect size ($d = .79$)]. All mean scores on the LIQ subscales were well above the median score of 3.5 on the 7-point scale. These results suggest that not only was the game effective for reviewing qualitative research concepts but that it also successfully incorporated motivational features that can influence learning in general. The particular game described in this study can be used with various content and incorporated in either an educational or therapeutic context.

Background

Game-based teaching and learning strategies are being used more commonly to promote student engagement and motivation (Anastasiadis et al., 2018; Plass et al., 2015; Wouters et al., 2013). Interactive games that involve collaboration and assist students with knowledge retention are seen not only as useful, but also beneficial for achieving learning outcomes (Stiller & Schworm, 2019) and self-efficacy (Oprins et al., 2015). Similarly, in therapeutic contexts, game-based learning has been used as a treatment modality, with goals embedded in games and play (Elaklouk et al., 2015; Oña et al., 2018; Whitlock et al., 2012). Student engagement with complex learning material, such as qualitative research constructs, can be daunting for learners (Bell, 2014; Probst et al., 2016). Health and social science programs often require learners to demonstrate competency in applying qualitative research principles (Probst et al., 2016). However, research courses and course content can be viewed negatively by students as both intimidating and anxiety provoking (Sidell, 2007). Using active learning strategies and making research material more learner-centered is one approach to stimulate effective learning (Bell, 2014). Game-based learning may be an answer to increasing student engagement and self-efficacy with complex learning material (Chanut & Lerdpornkulrat, 2016).

The literature describes the uses and benefits of games in education (Anastasidis et al., 2018; Oprins et al., 2015; Stiller & Schworm, 2019; Wouters et al., 2013). Despite this, few studies feature the systematic implementation and evaluation of serious games. This study examined the effectiveness of the use of a serious board game in an educational context to review qualitative research concepts using the constructs of the Game-based Evaluation Model (Oprins et al., 2015). The study findings may be of benefit to occupational therapists who incorporate therapeutic objectives in the context of play. By elucidating the underlying features that make serious games effective, both educators and occupational therapy practitioners may design more effective strategies for utilizing serious games to meet learning objectives and therapy goals.

Game-Based Learning and Serious Games

Game-based learning aims to engage learners with content in such a manner that the interaction encourages knowledge acquisition and retention. In game-based learning, game elements such as challenge and feedback are primarily intended for educational purposes (Gerber & Price, 2013; Myers, 2020). When games are used to test previously covered material and solidify concepts, they serve as a form of retrieval practice, an evidence-based approach to teaching and learning (Orlando, 2020). Game-based learning differs from gamification in that it is used to cover a specific educational topic or provide a review; whereas gamification involves immersion of game elements into educational ventures in a broader, more elaborate sense (Myers, 2020). As a type of game-based learning, serious games are designed to increase student engagement, thereby positively influencing learning outcomes (Chanut & Lerdpornkulrat, 2016).

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Serious games incorporate learning objectives in the context of competitive games with rules. While these games are entertaining and interactive, they merge learning goals and the goal of the game itself. Serious games have been utilized to make learning more effective by increasing engagement, challenge, interest, and enjoyment. Enjoyment and peaked intrigue during a low-stakes interaction with content is a secondary aim of serious games. These types of games can be useful study aids, especially when the content proves difficult to study (Orlando, 2020) and the learner presents with diminished self-efficacy for mastering the material. Serious games attempt to integrate elements of challenge and enjoyment to make learning more motivating and learner centered. Serious games require the active cognitive processing that is a prerequisite for effective and sustainable learning (Oprins et al., 2015). Since serious games may promote effective learning by making learning more motivating, interesting, and enjoyable, they are believed to facilitate self-efficacy and self-directed learning (Oprins et al., 2015; Roozeboom et al., 2017).

Serious games may also incorporate principles of social cognitive theory. Social cognitive theory maintains that learners are influenced by interactions shared with others (Bandura, 1986), not solely through direct, individual experiences. Learning can be influenced by the social interaction inherent in a serious game's design and the feedback provided by other players. If a student answers a game question incorrectly and reads the correct answer aloud, all players benefit. Similarly, learning can occur while the active player is being challenged and the social group of players are following along and thinking through the material as a game progresses. Social learning naturally takes place through the dynamic interaction of challenge, feedback, and building up of one's self-efficacy (Bandura & Cervone, 1983) as the learning material is reviewed within the context of an interactive game. Thus, in the social context of a game, there is not only motivation and pressure to answer questions correctly, there is the impact of knowledge shared by others.

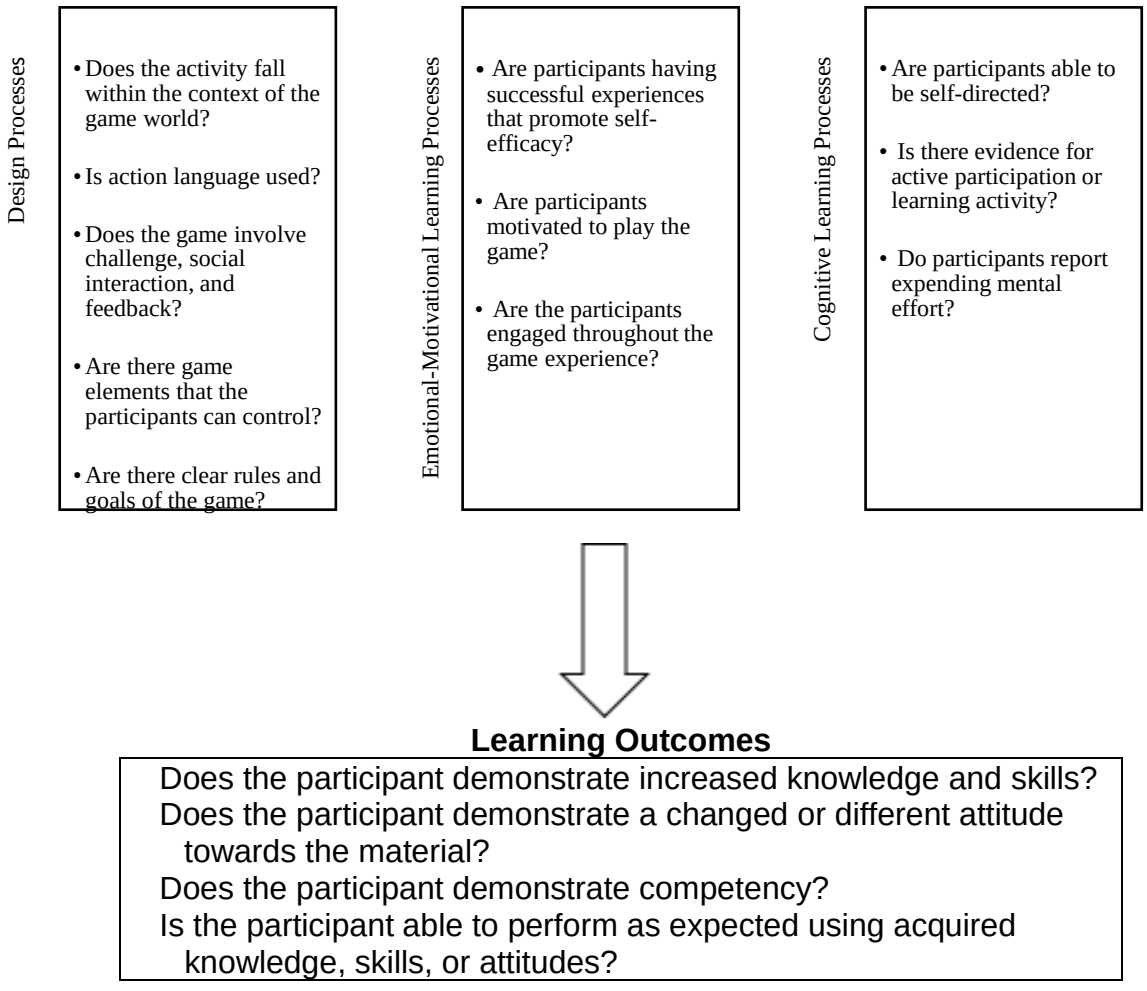
Studies indicate a positive effect of serious games on high quality learning, retention, feelings of control and challenge, and engagement. A meta-analysis found that using serious games increased learning to a significantly greater degree than conventional methods (Wouters et al., 2013). Students who participated in serious games demonstrated greater verbal and nonverbal knowledge as well as cognitive processes such as problem-solving in novel situations, although the effect sizes were small. Learning through serious games also resulted in greater retention of knowledge over time than conventional methods. Roozeboom et al. (2017) found that students who played serious games felt a greater sense of control over their learning process and perceived they had received more relevant feedback than those who were taught through classroom instruction. They also reported higher levels of active engagement and self-efficacy. Similarly, Oprins et al. (2015) described the positive effects of serious games on learning indicators such as feelings of control and challenge, provision of feedback, social interaction, and engagement. When compared to classroom instruction, serious games were significantly more effective for increasing these learning indicators (Oprins et al., 2015; Roozeboom et al., 2017; Wouters et al., 2013).

Game-Based Evaluation Model and Key Learning Indicators

The Game-based Evaluation Model (GEM; Oprins et al., 2015) provides a framework for validating the usefulness of a game-based learning method. GEM emphasizes evaluation of the effectiveness of a game based on emotional-motivational processes and cognitive factors in addition to the outcomes of the activity (see Figure 1). According to Oprins et al. (2015), self-efficacy, motivation, and engagement serve as the emotional-motivational indicators of learning; self-directedness, learning activity, and mental effort serve as the cognitive indicators. These emotional-motivational and cognitive indicators can be demonstrated both intrinsically and extrinsically, and by measuring them the educator may be able to identify aspects of the game that make it effective (Oprins et al., 2015).

Figure 1

Game-Based Evaluation Model (GEM) Framework for Process and Product Evaluation



Note: Based on Oprins and colleagues (2015) GEM

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Researchers have described interrelationships among the emotional-motivational and cognitive learning indicators. Self-efficacy, a key emotional-motivational process in the GEM framework (Oprins et al., 2015) and a central construct of social cognitive theory (Bandura & Cervone, 1983), is the belief in one's ability to meet a given challenge (Bandura, 1997). Self-efficacy is grown through mastery experiences (Bandura, 1997). While students move through the game, subsequently reinforcing their knowledge and understanding of the content, each correctly answered question validates their achievement, increasing their confidence and comfort-level with the material. As self-efficacy grows over the course of a game or series of games, so may the likelihood for high quality learning (Wouters et al., 2013).

Participant perceptions of self-efficacy, control, and challenge may influence other key learning indicators, including motivation and the propensity for self-directed learning (Hart & Mueller, 2014). Motivation suffers when the learner has low self-efficacy, the task requires excessive mental effort, and the perceived value or usefulness of the game is low (Hart & Mueller, 2014; Oprins et al., 2015). On the other hand, when an activity is enjoyable and engaging, motivation is heightened (Ryan, 1982). Motivation, in turn, drives behavior and engagement (Di Domenico & Ryan, 2017). Engagement can be both internal, involving cognitive processes such as concentration, and external, referring to observable behaviors such as interaction and participation (Oprins et al., 2015). A serious game may be a pathway to affecting students' thinking and motivation (Wouters et al., 2013).

Self-directedness, which involves both perceived competence and mental effort, occurs when the learner takes responsibility for his or her understanding or grasp of the content to be learned. The learner identifies and addresses knowledge gaps, and takes action, discovering adequate strategies for retaining and retrieving learned content. A motivated learner with strong self-efficacy in regard to mastering the material is more likely to demonstrate successful self-directedness (Booker, 2020; Hart & Mueller, 2014). As described in GEM, these interrelated learning indicators contribute to the success of a serious game.

While the literature strongly supports the positive outcomes of game-based learning and the usefulness of serious games (Anastasiadis et al., 2018; Plass et al., 2015; Stiller & Schworm, 2019; Wouters et al., 2013), few studies exist which examine the key learning indicators that contribute to the usefulness of serious games (Oprins et al., 2015; Roozeboom et al., 2017). Studies of the use of serious games in rehabilitation have focused primarily on how to incorporate game-based learning as a treatment modality (Elaklouk et al., 2015; Oña et al., 2018; Whitlock et al., 2012), without examining the underlying mechanisms that make game-based learning successful. Further, in therapy literature, serious games are almost exclusively virtual or involve a form of technology (Molina et al., 2014), but a serious board game could also be useful for meeting therapy goals. By examining key learning indicators that contribute to the success of serious games, educators and practitioners alike may design serious games that effectively meet learning objectives and therapy goals.

This study sought to analyze the effect of a particular serious game for reviewing qualitative research constructs, which are often perceived as intimidating to learn (Bell, 2014; Probst et al., 2016; Sidell, 2007). Two unique features of the study were its participants, the occupational therapy students, and its systematic use of the GEM framework (Oprins et al., 2015) to analyze the game's effect on key learning indicators (see Figure 1), specifically, perceived competence, effort/importance, value/usefulness, and interest/enjoyment as well as learning of content. The learning indicators examined in this study are important considerations when incorporating serious games in therapeutic as well as educational contexts. This study aims to address the following questions: What is the effect of a serious game on Master of Occupational Therapy (MOT) students' knowledge of qualitative research concepts? What are MOT students' perceptions of key learning indicators (interest/enjoyment, perceived competence, effort, and value/usefulness) during a serious game related to knowledge of qualitative research concepts?

Method

This one-group pretest-posttest study was granted approval by the university's institutional review board, and all participants signed an informed consent form.

Participants and Setting

Participants were recruited from one cohort of MOT students in a professional program located on a health science center campus in the mid-South region of the United States. The students had previously completed two evidence-based practice courses in which qualitative research concepts (e.g., qualitative research philosophy, designs, aspects of trustworthiness, sampling, data collection techniques, and data analysis) were introduced and explored. The study occurred during the students' second year in the program when they were enrolled in the third evidence-based practice course in the curriculum. Thirty-eight of the 39 students in the cohort volunteered to participate and completed the study. The 38 participants had a mean age of 24.5 years (range 22.5 years - 31.2 years). Thirty-six participants (94.7%) were White; 1 (2.6%) was Asian-American, and 1 (2.6%) was Hispanic-Latino. Thirty-six (94.7%) were female.

Procedure

Participants played the board game, *Snakes and Ladders* (SL), in groups of five or six (see Figure 2). This game was chosen since it had been used by other authors to reinforce practical concepts related to research (Warburton & Madge, 1994). However, modifications were made to Warburton and Madge's approach and the rules of the traditional SL game in order to require active and accurate review of specific concepts related to qualitative research.

As in the commercial game *Chutes and Ladders* (Milton Bradley, 1943), the students rolled dice and moved their counters forward on the game board, with the goal of being the first player to reach the last space at the top of the board. The traditional rules of SL were modified to incorporate "Stun the Snake" and "Slippery Slope" questions requiring active learning and retrieval practice related to qualitative research concepts

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(e.g., designs, aspects of trustworthiness, sampling, data collection techniques, and data analysis). These questions were developed by the researchers and based on content from the course textbook, *Bailey's Research for the Health Professional* (Hissong et al., 2015).

Figure 2

Classroom Game of Snakes and Ladders

As participants proceeded along the board, they sometimes landed on the head of a snake or the foot of a ladder. In the standard rules of SL, landing on the head of the snake requires the player to slide down the board to a lower space; whereas landing on the foot of a ladder allows the player to slide up the board to a higher space. The modified version of SL included an interactive element to incorporate retrieval practice and capitalize on collaborative and interactive social learning. The modified SL rules were projected at the front of the room and included the following instructions:

- Players who landed on the head of a snake or the foot of a ladder were required to answer a "Stun the Snake" or "Slippery Slope" question from decks of cards.
- Answering "Stun the Snake" questions correctly allowed students to remain at the head of a snake rather than sliding down the board.
- Incorrect answers to "Stun the Snake" questions resulted in sliding down the snake to move backward on the game board.
- Answering "Slippery Slope" questions correctly allowed students to proceed up the ladder and move forward on the game board.
- Incorrect answers to "Slippery Slope" questions caused students to "slip" and remain at the foot of the ladder.

No scripts were provided to allow for spontaneous social interaction and playfulness during the game. Students were allowed to provide each other with hints, because these hints may have facilitated knowledge retrieval, both during the game and afterward.

Debriefing was also incorporated once all student groups had completed their individual games. This debrief was conducted with the whole class and consisted of individual and group recall of research concepts, individual and group reflection on and identification of areas needing clarification, and opportunities for clarification of these points through small group and whole class discussion, instructor assistance, and reading the textbook.

Instruments and Data Collection

Participants completed a 25-question multiple choice test to measure knowledge of qualitative research concepts immediately prior to playing the game and again 5 days after playing the game to measure knowledge retention. Each correct answer was awarded 4 points to convert the scores to a 100-point scale. The tests were administered in a classroom setting via Qualtrics^{xm} survey software. There were no time limits, and no students requested accommodations when taking the tests. Both the pretest and posttest were developed by the researchers and designed to test the same concepts.

The Learning Indicators Questionnaire (LIQ), a seven-point Likert-type scale, was used to measure learning indicators, in accordance with GEM (Oprins et al., 2015). As in previous research (Ryan, 1982), the LIQ items were selected based on the variables of interest in this study. The LIQ was based on the Intrinsic Motivation Inventory developed by Ryan (1982). Using the seven-point scale, participants rated their level of agreement with the 20 items, with one indicating “not at all true” and seven indicating “very true.” Subscales of the LIQ measured Perceived Competence, Effort/Importance, Value/Usefulness, and Interest/ Enjoyment (see Figure 3). The LIQ was administered immediately following the posttest.

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Figure 3

Learning Indicators Questionnaire Items

Perceived Competence	I think I am pretty good at this activity.
	I think I did pretty well at this activity, compared to other students.
	I am satisfied with my performance at this task.
	This was an activity that I couldn't do very well.
Effort/ Importance	I put a lot of effort into this.
	I didn't try very hard to do well at this activity.
	I tried very hard on this activity.
	It was important to me to do well at this task.
	I didn't put much energy into this.
Value/ Usefulness	I believe this activity could be of some value to me.
	I think that doing this activity is useful for reviewing qualitative research concepts.
	I think this is important to do because it can help me learn qualitative research concepts.
	I think doing this activity could help me to remember qualitative research concepts.
	I believe doing this activity could be beneficial to me.
	I think this is an important activity.
Interest/ Enjoyment	I enjoyed doing this activity very much
	This activity was fun to do.
	I thought this was a boring activity.
	This activity did not hold my attention at all.
	I would describe this activity as very interesting.

Note: Based on Ryan (1982)

Data Analysis

The data were analyzed using SPSS® version 27. Descriptive statistics were calculated for the pre- and posttests as well as the LIQ. Internal consistency reliability of the LIQ subscales was analyzed using Cronbach's alpha. Paired *t*-tests were used to analyze mean differences in pre- and posttest scores, and Cohen's *d* was used to calculate effect sizes. Based on Cohen (1988), effect sizes were interpreted as 0.20, small effect; 0.50, medium effect; and 0.80, large effect.

Results

A dependent *t*-test revealed a statistically significant increase in mean scores on the posttest [$t(37) = 4.86$, $p < .001$; effect size medium to large ($d = .79$)]. All LIQ subscales demonstrated adequate internal consistency reliability (Cronbach's alphas ranged from .70 to .84). Eleven participants did not respond to all items on the Perceived Competence and Effort subscales, and 13 students did not respond to all items on the Interest subscale. These appeared to be random omissions. Mean scores were calculated for participants who responded to all items in the subscale (see Table 1). All mean scores on the LIQ subscales were well above the median score of 4 on the 7-point scale.

Table 1

Means and Standard Deviations for Each Outcome Measure

Outcome Measure	*M(SD)*
Pretest (*n* = 38)	76.74 (10.0)
Posttest (*n* = 38)	85.26 (10.4)
LIQ	
Perceived Competence (*n* = 27)	4.85 (.93)
Effort/Importance (*n* = 27)	5.56 (.77)
Value/Usefulness (*n* = 38)	5.83 (.88)
Interest/Enjoyment (*n* = 25)	6.09 (.77)

Note. M = mean; *SD* = standard deviation; LIQ = Learning Indicators Questionnaire

Discussion

These results suggest that not only was the SL game effective for reviewing qualitative research concepts in this group of participants but that the game also appeared to have incorporated motivational features that can influence learning in general. Participants perceived the game as interesting and enjoyable, and the mean score of the Interest/Enjoyment subscale was the highest rated of all the LIQ subscales. At the same time, participants found the game valuable and useful for their learning. When enjoyment is high, motivation and engagement is also likely to be high (Di Domenico & Ryan, 2017; Ryan, 1982) as seen here with the participants' ratings. The value placed on the activity as well as the level of interest could be indicative of the participants' internal and external motivation to concentrate and remain actively involved in the game (Ryan, 1982). The participants' ratings of the LIQ subscales were fairly consistent, as

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demonstrated by the small standard deviations for each of the subscales. Overall, these findings suggest that SL can be classified as a serious game and that it may have provided the just-right challenge, effectively meeting the intended learning objectives (Anastasiadis et al., 2018; Stiller & Schworm, 2019). Consistent with GEM, SL appears to facilitate the engagement and motivation that indicate learning (Di Dimenico & Ryan, 2017; Oprins et al., 2015).

In addition to motivation and engagement, Oprins and colleagues (2015) described self-efficacy as one of the emotional-motivational processes that indicate learning. It is interesting to note that Perceived Competence was rated lowest of the four LIQ subscales (although it was rated above the median of 4). In addition to facilitating engagement, this serious game incorporated retrieval practice and feedback and provided a challenge for the participants to overcome. Utilizing the serious game to motivate learners to review qualitative research may have facilitated the persistence and perseverance necessary when studying content that challenges students' self-efficacy—and may have fostered growth in self-efficacy related to knowledge of qualitative research concepts.

Another factor in the success of the SL game may have been its emphasis on mental effort. The questions incorporated in the game were designed to require retrieval practice, and the participants reported they did indeed expend effort during the game. Oprins and colleagues (2015) have identified mental effort as one of the cognitive processes that indicate learning. Course evaluation comments also suggested that the game was a successful learning activity, as 21% of the participants specifically mentioned SL as helpful to their learning. Sample narrative comments included:

- Snakes and Ladders was a very interactive game that addressed key concepts.
- The most helpful thing in this course to my learning was...fun games and activities to help us learn...because it addressed the topic in a fun & less stressful way for us to be able to understand it.

Also of note is the fact that several groups of participants chose to use the SL game (substituting different questions to address their therapeutic objectives) in another course when leading groups of college-aged students with intellectual disabilities. This also suggests that they may have valued the modified SL game as fun, motivating, and effective.

Unlike many electronic learning games, this board game included face-to-face social interactions with peers. Although not directed to do so, it was observed that the participants often provided hints to classmates who were unable to answer the questions posed to them, potentially reinforcing learning and facilitating improved retrieval for the questioner as well as the other players. Thus, the social, collaborative nature of the board game may have also contributed to the participants' increased knowledge of qualitative research concepts.

The reflective and self-directed nature of the debriefing used at the end of the class session may also have contributed to the success of this serious game. Consistent with GEM, processes that occur not only before and during a serious game, but also following, can have an important role in the learning experience (Oprins et al., 2015).

SL can be easily adapted for review of various content. Unlike gamification of an entire course, it requires a reasonable amount of preparation and allows for some degree of flexibility. Limiting gamification to incorporation of a board game to review particular content may take advantage of the motivational aspects while also avoiding the risk of over-use of gaming in a curriculum (Myers, 2020). Further, it seems reasonable to suggest that this game could be adapted for use in a therapeutic context, promoting motivation and providing the just-right challenge. Therapeutically, SL could be used to review patient education concepts such as home hazards, precautions, or health maintenance facts. Variations of play could be incorporated such as requiring skill demonstration and review or therapeutic exercises to progress through the game. As stated previously, participants who experienced SL in this project utilized the game to review and learn complex material through the incorporation of questions related to qualitative research constructs.

Limitations

Generalization of these findings to other programs is limited because of the small convenience sample from one occupational therapy program. Likewise, the SL questions, pretest, and posttest were specific to qualitative research concepts, and the effectiveness of the game for review of other content areas is unknown. The instruments used to measure the participants' retention of knowledge about qualitative research were also designed by the researchers, with unknown reliability and validity. However, there was a statistically significant small positive relationship (r = .439, p = .006) between the pretest and posttest. Similarly, the LIQ consisted of items chosen by the researchers based on the Intrinsic Motivation Inventory and the purpose of the study; however, this has been done in previous research (Oprins et al., 2015), and the LIQ scales used in this study demonstrated acceptable internal consistency reliability.

Recommendations for Future Research

Instructors who utilize serious games to meet learning outcomes should consider systematically examining the effectiveness of these nontraditional teaching and learning practices, including measurement of key learning indicators. Future research related to this specific serious game could focus on its use for facilitating learning in different content areas, across institutions, and with larger samples, as well as for meeting therapeutic goals in a treatment context.

Implications for Occupational Therapy Education and Practice

As emphasized by GEM, educators and practitioners who use serious games to facilitate learning should intentionally design the environment of the game, considering factors such as group size and other contextual factors that can promote engagement, social interaction, and interactive play. When designing a serious game, educators and

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practitioners need to consider the intended learning outcomes and strategies for capitalizing on social interaction to promote accomplishment of these outcomes. Also, matching student or client skills and learning needs can help ensure the just-right challenge when designing and implementing a serious game. Serious games incorporate rules and goals that 1) promote the player's active control over the content or strategies for game play, 2) provide feedback to inform the player about progress toward learning outcomes, 3) require mental effort, and 4) facilitate problem solving may be more effective for facilitating self-directedness and learning. Debriefing following the use of a serious game, incorporating reflective discussion and self-directed activities, is recommended (Oprins et al., 2015; Roozeboom et al., 2017).

Conclusion

In education, serious games can incorporate active learning, retrieval practice, and group interaction which may facilitate comprehension, application, analysis, and evaluation (Chanut & Lerdpornkulrat, 2016; Gerber & Price, 2013; Oprins et al., 2015, Roozeboom et al., 2017). Strategically incorporating serious games into an occupational therapy curriculum may be a feasible method for capturing student motivation and meeting learning goals. Participation in serious games during occupational therapy coursework may also provide a model for students for designing and using serious games with future clients.

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