COMPARATIVE STUDY OF GAME-BASED EPEDAGOGIES IN AN ONLINE UNDERGRADUATE COURSE

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ABSTRACT

Digital game-based learning (DGBL) has shown to be an effective approach to gamifying the learning experience in any course and learning environment. To make learning more active and engaging for students, college faculty can use educational technologies such as game-based student response systems (SRSs) and interactive PowerPoint games as a formative assessment for assessing student learning and improving learning outcomes in their courses. This quasi-experimental research study examined differences among undergraduate elearners' posttest summative scores comparing game-based epedagogies (Socrative vs. interactive PowerPoint game) using the Technological, Pedagogical, Content, and Knowledge (TPACK) theoretical framework. An independent t-test was used to test for differences in summative scores between the Socrative and interactive PowerPoint game group and there was a statistically significant difference between the two groups ($p < .05$). Results from the t-test showed that the interactive PowerPoint game group scored significantly higher compared to the Socrative group on the summative assessment. Two recommendations for practice were for higher education leadership to (a) encourage DGBL approaches for teaching and learning for elearners enrolled in an undergraduate degree program, and (b) to encourage college faculty to use game-based epedagogies such as game-based SRSs and interactive PowerPoint games as formative assessments to not only enhance their teaching but also improve student learning outcomes. A recommendation for future research is to conduct a quasi-experimental study with a between-groups design using interactive PowerPoint games to determine the causality of differences based on gender, course subject, and learning modality.

Keywords: *digital game-based learning, game-based student response systems, PowerPoint games, formative assessments, educational technology, active learning*

INTRODUCTION

Advances in educational technology have transformed how higher education faculty teach and how students learn in any environment. According to their website, the Association for Educational Communications and Technology (AECT, 2021) defines educational technology as "the study and ethical application of theory, research, and best practices to advance knowledge as well as mediate and improve learning and performance through the strategic design, management and implementation of learning and instructional processes and resources" (Educational Technology: A Definition with Commentary, n.p.). There are a variety of educational technologies and Web 2.0 tools that faculty can utilize to transform a classroom from a

faculty-centered to a student-centered environment and help faculty create a more engaging and interactive learning environment.

As evident in the research literature, the benefits of using educational technologies and Web 2.0 tools with a gamification approach to teaching and learning are vast. In fact, a growing body of research on digital game-based learning (DGBL) has shown that DGBL is becoming a prominent instructional approach in higher education and has the potential to enhance student motivation, engagement, and learning effectiveness (Abdul & Felicia, 2015; Chang et al., 2018; Lee et al., 2016; Perini et al., 2018; Turner et al., 2018). More importantly, empirical studies on digital games or gamified online quizzes using technology in university classrooms have shown positive results in facilitating student learning and improving learning outcomes (Badia Valiente et al., 2016; Karaaslan et al., 2018; Sanchez et al., 2020). In addition to making learning more active and engaging, faculty can use digital games or gamified online quizzes as a formative assessment for assessing their teaching effectiveness and students' learning (Elmahdi et al., 2018; Robinson, 2018; Smith & Mader, 2015).

RESEARCH BACKGROUND

Game-based student response systems (SRSs), for instance, are one of those educational technology tools that instructors could use during classroom instruction to engage students to undertake active learning roles (Bicen & Kocakoyun, 2017; Zou & Lambert, 2017; Nawalaniec, 2015; Sprague, 2016; Turzan & Meral, 2018). A primary function of an SRS is to facilitate interaction between students and instructor using hand-held electronic devices such as a smart phone, laptop, tablet, or notebook. With the effective use of game-based SRSs, both instructor and students have access to the students' responses on multiple-choice, true-or-false, closed-ended, and open-ended questions. This is beneficial because it provides an opportunity for instructors to assess what students know and any gaps in their knowledge acquisition, while adjusting their teaching methods to enhance the learning experience.

Further, some game-based SRSs can be includd within a presentation software, such as Microsoft PowerPoint, to increase student engagement, promote interaction, and enhance learning effectiveness (Laici & Pentucci, 2019). Researchers have experimented with various types of game-based SRSs including classroom response systems (CRS) (Cheng & Wang, 2019; Wong, 2016a, 2016b), audience response systems (ARS) (Funnell, 2017; Tivener & Hetzler, 2015), interactive response systems (IRS) (Datta et al., 2015; Wang, 2017, 2018), polling systems (Deng, 2019; Walklet et al., 2016), and clickers (Buil et al., 2019; Voith et al., 2018). Popular game-based SRSs reported in the literature include Socrative (Aslan & Seker, 2017; El Shaban, 2017; Guarascio et al., 2017; Munusamy et al., 2019; Pérez Garcias & Marín, 2016; Sprague, 2016), Poll Everywhere (Deng, 2019), Kahoot! (Bicen & Kocakoyun, 2017; Rahmahani et al., 2020; Yabuno et al., 2019), Plickers (Elmahdi et al., 2018), Quizlet, NearPod, and Powtoon (Karaaslan et al., 2018). Based on results from empirical studies reported in the literature, game-based SRSs have shown to be an effective formative assessment for monitoring student learning, adjusting teaching, and most of all, assessing students' current knowledge of course concepts (Robinson, 2018; Smith & Mader, 2015). Although research on game-based SRSs is extensive, results from experimental or quasi-experimental studies using game-based SRSs have been varied and not a single study examined the effect of game-based SRSs on learning outcomes in distance education courses. Thus, there is a need for additional research and empirical studies investigating the use of digital games that support the learning of nontraditional students (Turner et al., 2018).

Recently, Socrative has been adopted as a widely used interactive technology used in higher education, which is a mobile polling application that allow students to participate anonymously and asynchronously in real time (Kokina & Juras, 2017; Nawalaniec, 2015). Socrative is a free web tool that allow instructors to create gamified online quizzes and use them in real time to increase opportunities for student engagement, motivation, and most of all, to improve assessment of student learning outcomes (Abdulla, 2018; El Shaban, 2017; Mendez et al., 2018; Pérez Garcias & Marín, 2016). Socrative also provides an opportunity for students who may be too shy, lack confidence, or are too intimidated to speak in front of their peers to open up and respond to the questions without fear of judgment. In addition, students' responses to surveys and questionnaires have been overwhelmingly

positive in regard to the use of Socrative in traditional college classrooms (Aslan & Seker, 2017; Badia Valiente et al., 2016; Zou & Lambert, 2017; Guarascio et al., 2017; Munusamy et al., 2019; Pérez Garcias & Marín, 2016; Sprague, 2016; Wong, 2016a, 2016b).

Although there have been positive results from using Socrative as an interactive tool in university classrooms, many educators are exploring the use of interactive Microsoft PowerPoint games as a teaching and learning pedagogy. Microsoft PowerPoint is commonly used in oral and online presentations in classrooms; however, faculty can transform these presentations into a fun, interactive game that is engaging for students, which can assist students in the development of important skills (Countryman, 2017; Jayaratne, & Moore, 2017; Shen, 2018). Interactive PowerPoint games such as Jeopardy! And Twenty Questions are popular games reported in the literature and have been extensively used in traditional educational settings (Aljezawi & Albashtawy, 2015; Min & Mustain, 2017). Although interactive PowerPoint games have been widely used and tested in traditional classrooms, the research findings regarding their effectiveness in online courses have been inconclusive (Squire, 2019). Therefore, further studies are needed to better understand interactive PowerPoint games as an elearning and teaching pedagogy.

Statement of the Problem

Many research studies have used game-based SRS tools and interactive PowerPoint games to explore their usefulness within educational settings. However, a review of the relevant literature shows that several gaps have emerged. First, none of these studies explored the effects of using these game-based epedagogies on student learning outcomes in an online course. Squire (2019) was the first researcher to test the effectiveness of using an interactive PowerPoint game as a formative assessment for improving learning outcomes in an online undergraduate course. However, when compared to a traditional method (study guide), no significant findings were found in posttest scores. Also, of the empirical studies that explored Socrative as a game-based formative assessment, none of them were in online or distance education courses. Therefore, further studies are needed to assess the effectiveness of using interactive PowerPoint games and Socrative as an instructional and learning pedagogy for elearners. Second, none of the previous studies exclusively compared the effectiveness of using Socrative and interactive PowerPoint games with the active learning approach for enhancing teaching and learning for nontraditional undergraduate students. Thus, to address these two gaps, the current study tested and compared the effectiveness of using game-based epedagogies such as Socrative and an interactive PowerPoint game aimed to promote students' active learning and, ultimately, to improve elearners' posttest scores on a summative assessment.

Purpose of the Study

The purpose of this quasi-experimental study was to compare the effectiveness of utilizing game-based epedagogies using a Web 2.0 tool such as Socrative and an interactive PowerPoint game as a formative assessment for improving posttest scores on a summative assessment in an online undergraduate course. A posttest only design was used to test differences in scores between two intervention groups (Socrative vs. interactive PowerPoint game). Both groups received the same course content, material, and instruction by the course instructor; however, one group of students received a game-based epedagogy using Socrative as the formative assessment while the second group received an interactive PowerPoint game as a formative assessment. Both game-based epedagogies contained the same practice quiz questions, which were in multiple-choice format, and both games were posted on Monday of Week 4 in the Topic 4 discussion forum board. To better understand how game-based epedagogies impact student learning in an online undergraduate course, the Technological, Pedagogical, Content, and Knowledge (TPACK) framework was used to guide the study.

Theoretical Framework

The TPACK framework, originally introduced by Mishra and Koehler (2006), represents the integration of technological, pedagogical, and content knowledge in teaching, learning, and instructional design. Mishra and Koehler (2006) and Koehler and Mishra (2009) contend that the TPACK framework is innovative, effective, and complete because it takes into account technology, pedagogy, and course content as a way of solving instructional problems. To apply the TPACK framework for game design, educators must be able to identify the advantages and disadvantages of using

different educational technologies and their impact on student success. When designing instructional techniques using current technologies and digital tools, the TPACK framework provides a promising solution for higher education faculty teaching online courses (Saltan, 2017). Since Socrative and interactive PowerPoint games are not content specific, they provide a flexible way to deliver content to students using technology that is easily accessible and user friendly. In addition, interactive PowerPoint games support a constructivist pedagogical view and can be used as an instructional tool for game design (Siko & Barbour, 2012, 2016). For this empirical study, the TPACK framework was used to better understand how technology, pedagogy, and course content could affect students' retention of knowledge using DGBL as the approach to assessing learning in an online undergraduate course. To study the problem, the following research question and hypotheses were as follows:

Research Question

> **Q1.** Is there a significant difference in posttest scores between elearners who received a formative assessment using Socrative compared to elearners who received a formative assessment using an interactive PowerPoint game?

Hypotheses

$H1_0$. There was no significant difference in posttest scores between elearners who received a formative assessment using Socrative compared to elearners who received a formative assessment using an interactive PowerPoint game.

$H1_A$. There was a significant difference in posttest scores between elearners who received a formative assessment using Socrative compared to elearners who received a formative assessment using an interactive PowerPoint game.

LITERATURE REVIEW

As evident from the research literature, DGBL is becoming a popular instructional approach in higher education and there is much research on the effectiveness of using digital games or gamified online quizzes in university classrooms (Chang et al., 2018; Erhel & Jamet, 2016; Hung et al., 2018; Lee et al., 2016; Perini et al., 2018; Turner et al., 2018). Using educational technologies or Web 2.0 tools, higher education faculty can design and integrate various forms of digital games, gamified online quizzes, or gaming activities into the course curriculum. Results from relevant studies have indicated that digital games or gamified online quizzes can be used to promote active learning and support faculty in teaching course content for undergraduate students in blended learning environments (Karaaslan et al., 2018) and traditional classrooms (Lee et al., 2016; Sanchez et al., 2020). To test the effectiveness of using game-based learning methods or pedagogies in higher education classrooms, the TPACK framework was often referred to in the literature. Therefore, the research findings from empirical studies using the TPACK framework, game-based SRS tools, Socrative, and interactive PowerPoint games as a teaching and learning pedagogy are further discussed.

TPACK Framework

The TPACK framework developed by Mishra and Koehler (2006) and Koehler and Mishra (2009) provides a promising solution for pedagogical integration and innovation (Saltan, 2017; Sheffield et al., 2015; Siko & Barbour, 2012, 2016). Using a case study design, Sheffield et al. (2015) rearticulated the TPACK framework by revising the "C" with "S" which stands for "science," to design curriculum for science education using Web 2.0 tools. To examine the success of designing a curriculum unit using Web 2.0 tools, Sheffield et al. (2015) conducted pre- and postanonymous online surveys with 219 preservice teachers in the Bachelor of Education Primary and Early Childhood programme in Australia enrolled both on campus and online. Based on the results from the surveys, 90% of preservice teachers reported that the Web 2.0 tools improved their understanding of science concepts and 94% of students reported an increase in their knowledge and confidence of Web 2.0 tools in supporting scientific inquiry in science (Sheffield et al., 2015). Thus, the findings of the case study support the TPACK framework and, suggest that it can be used for game-based design for online classes.

Using a quasi-experimental pretest-posttest design, Saltan (2017) examined the impact of online case-based learning, which consisted of ten video cases developed by the researcher on 160 preservice classroom teachers' self-confidence

and pedagogic knowledge on TPACK. Data from TPACK pretest and posttest scores indicated a significant difference in TCK and TK subdomains, but preservice teachers' self-confidence on technological pedagogical content did not improve (Saltan, 2017). Not only can the TPACK framework be useful in designing online tools for nontraditional undergraduate students, Siko and Barbour (2012, 2016) argued that designing homemade PowerPoint games as a pedagogy for game-design is aligned with the TPACK framework.

Siko and Barbour (2012) offered several justifications for the use of homemade PowerPoint games as an instructional tool for student motivation, engagement, and learning. First, PowerPoint games come from a constructionist philosophy, in that creating games can foster active learning. Second, PowerPoint games can provide a narrative for students through digital storytelling. Third, creating questions in PowerPoint games can scaffold student learning (Siko & Barbour, 2012). Despite these justifications, research on interactive PowerPoint games as an epedagogy for online learners has been limited and the results about its effectiveness have been inconclusive (Squire, 2019). Therefore, to study the impact interactive PowerPoint games and game-based SRS tools have on student learning outcomes in an online undergraduate course, the TPACK framework was used to guide this study.

Game-Based Student Response Systems

To facilitate and assess learning during the instructional period, higher education faculty can transform these digital games into a fun formative assessment using game-based SRS tools (Laici & Pentucci, 2019). Game-based SRS tools have shown to enhance classroom instruction and provide meaningful feedback for college students (Abdulla, 2018; Buil et al., 2019; Carroll et al., 2018; Voith et al., 2018). Popular game-based SRSs tried in traditional college classrooms using a gamification approach include Socrative (Badia Valiente et al., 2016; El Shaban, 2017; Guarascio et al., 2017; Munusamy et al., 2019; Pérez Garcias & Marín, 2016; Sprague, 2016), Kahoot! (Bicen & Kocakoyun, 2017; Rahmahani et al., 2020; Yabuno et al., 2019), Mentimeter (Joshi et al., 2021; Wood, 2020), TopHat (Feraco et al., 2020; LaDue & Shipley, 2018; Ma et al., 2018), NearPod (Tornwall et al., 2020), TurningPoint (Lee et al., 2015; Stowell, 2015), KeyPad (Sawang et al., 2017), Plickers (Elmahidi et al., 2018), Quizizz (Asiksoy & Sorakin, 2018), Poll Everywhere (Deng, 2019; Walklet et al., 2016; Wong, 2016a), and Quizlet and Powtoon (Karaaslan et al., 2018). Although there is an abundance of SRS tools available to students and faculty, some digital tools are more effective than others depending on the classroom size, course content, duration of teaching sessions, faculty comfort with technology, quality of game design, and students' individual learning preferences (Laici & Pentucci, 2019). For this study, Socrative was chosen as a game-based SRS tool and much research has been done on its usefulness in higher education classrooms.

Socrative

Socrative, a digital Web 2.0 tool used to gamify online quizzes, has shown to be an effective assessment tool for increasing student engagement and promoting active learning in traditional college classrooms (Abdulla, 2018; Aslan & Seker, 2017; Badia Valiente et al., 2016; Zou & Lambert, 2017; El Shaban, 2017; Guarascio et al., 2017; Kokina & Juras, 2017; Mendez et al., 2018; Munusamy et al., 2019; Pérez Garcias & Marín, 2016; Sprague, 2016). For instance, Abdulla (2018) examined the use of Socrative for teaching physiology and supporting the learning of medical students in University College Cork, Ireland. At the end of the instructional period, students were asked to complete a survey and an independent *t*-test was conducted to test for differences in course performance. The results indicated that there was a significant difference in class performance when Socrative was used as an assessment tool compared to students who did not use Socrative. In addition, 85% of students reported that Socrative enhanced their participation in class and 88% indicated that Socrative was very useful in increasing their understanding of course material (Abdulla, 2018). Guarascio et al. (2017) also conducted a quasi-experimental study to examine the impact Socrative had on the delivery of clinical pharmacy instruction among 169 students enrolled in a Doctor of Pharmacy program. To compare differences in students' perception and student engagement using Socrative and a traditional SRS (TurningPoint), they conducted a survey and the results showed that the students preferred Socrative in comparison with traditional SRS method. Overall, the students felt

that Socrative encouraged class participation and provided meaningful feedback (Guarascio et al., 2017).

Other quasi-experimental studies using Socrative as a gamified formative assessment for student learning also showed positive results in improving test scores and enhancing student satisfaction and learning experience in the classroom for preservice teachers (Pérez Garcias & Marín, 2016). Mendez et al. (2018) also studied the use of Socrative for improving reading speed and the logical reasoning of 109 future preschool teachers using the Test of Logical Thinking and compared test results with first-, second-, and third-year students. Interestingly, first-year students did not see any improvement in their test scores compared to the control group. However, third-year students achieved the best results in reading and logical reasoning in comparison to first-year students, suggesting that Socrative can be a useful formative assessment (Mendez et al., 2018). Although the number of empirical studies using a pretest and posttest design is very limited, numerous studies reported in the literature used a survey research approach to better understand students' perceptions of using Socrative as an assessment tool. For example, Aslan and Seker (2017) conducted a survey with 53 preservice teachers. The students' responses to the open-ended questions on a survey indicated that more than 90% of students enjoyed using Socrative and felt that the program increased their motivation and reinforced their learning in class.

Similar to Aslan and Seker (2017), Badia Valiente et al. (2016) studied the effects of using Socrative as a gamified formative assessment for promoting active participation and increasing knowledge acquisition among 103 college students enrolled in three different engineering courses at the Universitat Politecnica de Valencia. Based on the results from a student survey, 88% of students agreed that the tool was very easy to use and useful for self-assessment, 82% stated that Socrative promoted participation in the course, and 85% felt that the tool was interesting (Badia Valiente et al., 2016). In another study using survey research, Zou and Lambert (2017) compared the use of Socrative, TodaysMeet, and Google Drive with traditional methods among 93 non-English major freshmen students enrolled at Hong Kong Polytechnic University, and the results from the survey showed that 90% of students found the digital technologies the most effective approach to feedback. Using a qualitative approach, El Shaban (2017) found that Socrative was an effective way to promote English second language learners' active learning. Most of the students reported that Socrative activities encouraged them to interact and think more critically and collaboratively (El Shaban, 2017).

Moreover, Sprague (2016) examined eight ESL graduate students' perceptions about the use of Socrative exit tickets at a four-year university in the United States using an anonymous survey. Based on the survey, 87% of students indicated that Socrative was easy to use and useful for improving their English, 75% of students reported that they felt comfortable sharing their answers when they would have otherwise not said anything out loud, and 100% of students stated that Socrative increased their comfort level in the course (Sprague, 2016). In another study, Munusamy et al. (2019) compared students' perceptions of the use of Socrative and Yammer to promote learning in two undergraduate pharmacy education courses at Qatar University. A presurvey was conducted prior to the intervention and a postsurvey was administered after the intervention to assess differences in students' perceptions when online tools are used (Munusamy et al., 2019). Responses from the presurvey indicated that more than 90% of students were willing to try out the new interactive learning tools in the classroom setting and 50% agreed that using the technology would better prepare them for the class lecture. In the postsurvey, however, 100% of the students reported that they enjoyed the use of the online tools and felt that they enhanced their level of understanding of the lecture content. Nonetheless, the presurvey and postsurvey results were consistent in that the majority of students favored online tools such as Socrative and they felt the tool enhanced their learning experience and encouraged interactive learning (Munusamy et al., 2019).

As evident from the literature, the positive effects of using a game-based SRS, such as Socrative, on student engagement, motivation, interaction, and satisfaction in blended learning environments and face-to-face classroom settings are well documented. However, little is known about the benefits of game-based SRS in distance education courses (Turner et al., 2018). Therefore, further studies are needed to address this gap in the

literature. Not only has the use of game-based SRS tools such as Socrative shown promising results in making classrooms more engaging and fun for undergraduate students, interactive PowerPoint games can also be used as an effective teaching and learning pedagogy.

Interactive PowerPoint Games

Although very few empirical studies explore the use of interactive PowerPoint games as a teaching and learning pedagogy, research findings regarding their effectiveness in improving learning outcomes for traditional students are mixed. For example, Brinley Rajagopal et al. (2020) designed a PowerPoint lecture in the form of a game, Family Feud, to test medical residents' knowledge of nervous system disorders, and based on learner feedback and class observations, learners were engaged and the verbal feedback regarding the use of the game was overwhelming positive and some learners requested more sessions using a similar game. Using a flipped classroom approach for information literacy instruction, Shen (2018) examined the use of an interactive PowerPoint, which incorporated elements of personalization and group activities, on students' perception of the effectiveness and feasibility of the design. Interviews were conducted and three of the five participants responded and said they liked the interactive PowerPoint, but all of them were concerned about the complexity of the PowerPoint. They did not like having multiple options to choose from and felt that the PowerPoint was difficult to navigate (Shen, 2018).

In another study, Courtier et al. (2016) assessed the learning of medical students using an interactive digital game compared to an interactive-style didactic lecture, and the results from an end-of-rotation exam indicated that students in the lecture group had higher test scores compared to those in the game group. Using a *t*-test, the results indicate that there was no statistically significant difference between the lecture and game groups. This suggests that the traditional lecture was more effective than the digital game. On the contrary, Aljezawi and Albashtawy (2015) proved that using a Jeopardy!-style game format, compared to a didactic lecture in teaching nursing education to four-year nursing students, showed greater information retention of key concepts. Similar to Aljezawi and Albashtaway (2015), Bullard and Anderson (2014) conducted a quasi-experimental mixed methods study to assess the effectiveness of using a Jeopardy! and Twenty Questions game-style format for teaching college students' basic grammar skills compared to traditional methods, and the posttest scores in the quiz-game format were statistically significant.

Further, other research that explored the impact of interactive PowerPoint games on student learning were reflection practices, not empirical studies. For example, Moncada and Moncada (2014) designed an interactive game, similar to that of the popular television game show Hollywood Squares and the board game Connect Four, as a review tool to help accounting students learn, understand, and apply core concepts successfully. In their conclusion, they contend that the games helped students apply class concepts and made class time entertaining. Countryman (2017) also designed an interactive PowerPoint game similar to Jeopardy as a classroom review tool in a Forages course to help students prepare for the course exam, as well as to increase student interaction and track their progress in the course. Like Moncada and Moncada (2014), Countryman (2017) also recommended the use of Jeopardy games to help students study and review for exams and to increase student engagement and interaction in class. In a similar reflection practice, Min and Mustain (2017) used a Jeopardy game formatted quiz in their agricultural science courses at Kansas State University to increase student interaction and to assess students' retention of knowledge of key concepts. As suggested by Min and Mustain (2017), Jeopardy games can be used to provide a review tool for students as a way to increase interaction and track and monitor student learning. Sandiuc (2018) also created a Jeopardy game to help students in the Naval Academy learn English and although no empirical results were reported, Sandiuc (2018) claimed that the game improved students' maritime vocabulary, enhanced their vocabulary comprehension and production, and helped develop their professional communication skills.

Generally speaking, the use of interactive PowerPoints in traditional classrooms has shown positive results in improving learning outcomes. However, the results are limited because very few studies exist to draw accurate conclusions about their effectiveness in traditional, blended,

and online courses. More importantly, the use of interactive PowerPoint games as an elearning and instructional pedagogy in online settings is novel and little is known about the effectiveness of using such games for improving student learning (Squire, 2019). Therefore, further empirical studies are needed to address this gap in the literature.

RESEARCH METHOD

To study the research problem, I conducted a comparative quantitative study to examine the difference between posttest scores of two intervention groups (Socrative vs. interactive PowerPoint game). During Week 3, elearners were required to complete and submit a set of traditional flash cards to prepare for the Topic 4 quiz (summative assessment) as a graded deliverable. Therefore, no control group was included in this study for comparing the effectiveness of Socrative vs. interactive PowerPoint game as an intervention tool for improving learning outcomes for nontraditional undergraduate students. According to Jackson (2012), using a pretest-posttest design can strengthen the validity of the research results and is more sophisticated, but not considered necessary, as long as the instructor uses a sufficiently large sample size. Therefore, a quasi-experimental study with a between-subjects, posttest only design was appropriate for this study. In addition to using inferential statistics to test for differences between posttest scores, the effect size was calculated and reported to measure the size of the difference and to strengthen the validity of the *t*-test.

Population and Sample

The target population for this study was the estimated 3,000 elearners enrolled in an undergraduate philosophy course at a four-year university in the Southwestern United States. The sampling frame for elearners was 218 undergraduate elearners in the 2019/2020 academic year. Prior to the study, I assigned five course sections to the Socrative group and five course sections to the interactive PowerPoint game group, consisting of 101 students in the Socrative group and 117 students in the interactive PowerPoint game group. Since this was a quasi-experimental study where participants were already part of a group, random assignment to intervention groups was not necessary (Jackson, 2012). Before conducting the study, I obtained site authorization and Institutional Review Board (IRB) approval for the purpose of investigating only the existence of game-based epedagogies and their effect on student learning outcomes in an online undergraduate course.

Materials/Instrumentation

Quantitative data consisted of the summative assessment scores (Topic 4 Fallacies Quiz). To measure student learning, posttest scores from the summative assessment (Topic 4 Fallacies Quiz) were auto generated in the online LMS and recorded in the student and faculty course gradebook. The summative assessment, an online fallacies quiz included in the study, consisted of 10 multiple choice questions based on state standards and was designed in house by the institution's Curriculum, Development, and Design department (CDD) in collaboration with faculty, instructional designers, and curriculum developers. The quiz questions were tested and validated (CDD, 2019-2020). Formative assessments included in the study were the game-based epedagogies, Socrative, and an interactive PowerPoint game. These were designed and implemented by me to assist students in preparing for the Topic 4 Fallacies Quiz for the purpose of testing the effectiveness on students' posttest scores. I obtained permission to use quantitative data from the research setting.

Study Procedures

Prior to data collection, site authorization and IRB approval were obtained. The study was conducted during the 2019/2020 academic year and there were two groups in the selected online course, which made it a convenient choice for the between-groups analysis. The two teaching interventions were the interactive PowerPoint game and Socrative, a game-based student response system. To minimize bias, the primary investigator was the instructor who taught the selected course. The same content was delivered over the same length of time for both groups, and prior to the instructional period, students were informed that participating in this study was voluntarily and that their participation had no impact on their grade in the course. Students were assigned to one of the two instruction groups (Socrative vs. interactive PowerPoint game). After the instructional period, both groups were required to take the summative assessment at the end of Week 4 of the selected course, and the students had access to the same

resources to prepare for the quiz (Logical Fallacies media piece, chapter 4 of the text, and fallacy flashcards). The quiz scores were autogenerated in the online LMS and recorded in the student's gradebook. After Week 4 of the selected course, data archived through the online LMS were collected from the faculty gradebook of 10 course sections that utilized the interactive PowerPoint game and Socrative as a game-based epedagogy. Posttest scores were collected, entered in Excel, coded, and later transferred to SPSS for further analysis.

Data Collection and Analysis

At the end of Week 4 of the selected online course, I recorded the posttest scores from the summative assessment (Topic 4 Fallacies Quiz) into SPSS for further analysis. The data collected were coded to avoid direct identification of the students selected in the study. Therefore, no student identifying information was used and scores were not connected to any specific student. To test for differences in posttest score, an independent *t*-test was used. An independent *t*-test is useful when there are two experimental conditions and different participants have been used in each condition (Field, 2009). To ensure that the data met the assumption requirements of a *t*-test, a Levene's test was conducted and data violated the assumption of homogeneity of variances, which suggested that the variances in the two groups were different. However, this could be due to the large sample size, so to double check, Hartley's Fmax, also known as the variance ratio was calculated, and this ratio (1.187) was compared to the critical values published by Hartley (Field, 2009). According to the Hartley chart, for a sample size of 200 or more the ratio should be below 2 or 1 (1.666) and the ratio was 1.187, therefore, suggesting that the variance was homogeneous and the *t*-statistic was a reliable calculation for testing for differences in mean scores (Field, 2009).

Assumptions

Investigating game-based epedagogies on learning outcomes in a four-year university will involve data collection from a single institution; therefore, the results cannot be generalized in other four-year universities. Future research on game-based epedagogies and student learning will have to focus on a larger number of institutions in order to draw accurate conclusions about the effectiveness of game-based epedagogies and their impact on student learning and success in four-year universities. However, the findings of the research can be seen as the first step in better understanding how game-based epedagogies can affect learning outcomes in a distance education course designed for first-year learners. In the current research, it was expected that elearners who participated in this study were at least 18 years of age and older and that they were diverse in their academic background, ethnicity, religion, socio-economic status, gender, geographical location, religious beliefs, and student enrollment status. However, these factors should not adversely affect the results to be obtained.

The institution under investigation has an internal grading system that is embedded in the course design and involves awarding points based on correct answers from multiple choice questions. The grading system for the summative assessment quiz may impact the final grade awarded in the course, but it is weighted with other online course deliverables such as assignments, discussion questions, and class participation. It was also assumed that there would be few scores (outliers) that will greatly influence the outcome of the study. Lastly, it was assumed that students were familiar with PowerPoint and the multimedia features within.

ETHICAL CONSIDERATIONS

Ethical approval was sought and granted by the Center for Innovation and Research and Teaching (CIRT) and IRB at the site institution. Online consent was obtained from students who agreed to participate, and they were also informed that they had the right to withdraw from the study at any point and that it would not affect their grade in the course. The confidentiality and anonymity of the students was ensured throughout the study and no identifying student information was linked to their posttest score.

FINDINGS

An independent *t*-test examined the effect of the intervention (Socrative vs. interactive PowerPoint game) on posttest scores. Table 1 includes cell means and standard deviations for each condition. On average, elearners who received the interactive PowerPoint game as a formative assessment scored significantly higher on the summative assessment (M = 41.03, SE = .727) than compared to elearners

Table 1. Summary of Descriptive Statistics on Game-Based Epedagogies

Intervention	N	M	SD	Error M
Score	Socrative	101	36.88	10.145	1.009
	PPT Game	117	41.03	7.866	.727

Note. N=18 Table 1. Summary of Descriptive Statistics on Game-Based Epedagogies

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who received the Socrative game as a formative assessment (M = 36.88, SE = 1.01).

Table 2 includes the results from the independent *t*-test. Using a 95% confidence interval and a two-tailed test, the value of *p* is .001, which is less than .05, and it can be concluded here that there was a significant difference between the means of these two samples. In terms of the quasi-experimental study, the results sho that the interactive PowerPoint game was more effective than the Socrative game. To discover whether the effect was substantive, I calculated the effect size, which was .24. This difference was significant $t\ (216) = -3.33$, $p < .05$ and it represented a medium-sized effect $r = .24$.

Evaluation of Findings

Two hundred and eighteen elearners participated in the study (101 students in the Socrative group, 117 students in the interactive PowerPoint game group). To examine Research Question 1, an independent *t*-test was conducted and the findings indicated a statistical difference between the two groups. The mean difference between the two groups' scores was −4.144 with a 95% confidence interval ranging from −6.552 to −1.737. The *t*-test indicated that the test scores of the interactive PowerPoint game group were significantly higher ($t = -3.33$, $p < .05$) than those in the Socrative group with a medium effect size, $r = .24$. Therefore, the *t-statistic* suggests that the null hypothesis can be rejected and that there is evidence to support the alternative hypothesis. This finding is compared and contrasted with current research.

Hypothesis 1 results indicates a significant difference in posttest scores based on the game-based epedagogy used to facilitate teaching and learning for first-year distance education students. This finding is consistent with previous quantitative research findings that considered game-based learning with PowerPoint compared to non-game-based learning and found positive effects on student learning outcomes in traditional undergraduate classrooms (Aljezawi & Albashtawy, 2015; Bullard & Anderson, 2014). In another study,

Table 2. Independent t-Test for Game-Based Epedagogies

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference		
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper	
Score	Equal variances assumed	8.200	.005	-3.393	216	.001	-4.144	1.221	-6.552	-1.737
	Equal variances not assumed			-3.331	187.244	.001	-4.144	1.244	-6.599	-1.690

Note. *N=218. CI=confidence interval, p<.05.*

Brinley Rajagopal et al. (2020) used a PowerPoint lecture created in the form of the game, Family Feud, and based on survey results, learners were engaged, enthusiastic, and requested more sessions using a similar game. Countryman (2017) used a Jeopardy game in Forage courses at Kansas State University and contended that Jeopardy games can be used as a form of classroom review to increase student interaction and knowledge comprehension of the course material. Moncada and Moncada (2014) also utilized PowerPoint to design a game based on the popular television game show Hollywood Squares and the Milton Bradley board game Connect Four to teach introductory accounting concepts to undergraduate students and found that the games were effective in gamifying the learning process.

Despite positive outcomes, previous research studies involving interactive PowerPoint games had failed to show significant differences in student learning in a distance learning course (such as Squire, 2019). Although in a traditional classroom setting, Courtier et al. (2016) conducted a two-armed experience to evaluate student satisfaction and content mastery for an introductory pediatric radiology course using an interactive digital game using PPT in a tic-tac-toe format. It compared pediatric radiology game content to a traditional didactic lecture using PPT and *t*-test results, which indicated that students in the lecture group had higher test scores compared to students in the game group. In addition, students in the lecture group reported greater understanding and recall of the material than students in the game group. Also, students in the lecture group perceived the lecture to be more enjoyable compared to students in the game group. In essence, the results showed that students in the lecture group had a better learning experience over a digital game module using the same software, PowerPoint (Courtier et al., 2016).

Furthermore, a number of empirical studies using Socrative as a teaching and learning pedagogy in traditional undergraduate classrooms showed positive outcomes on student learning (Abdulla, 2018; Aslan & Seker, 2017; Munusamy et al., 2019; Pérez Garcias & Marín, 2016). Karaaslan et al. (2018) investigated the use of various game-based SRSs on student learning outcomes in a blended learning course and found positive results in learning gains. Kokina and Juras (2017) suggested the use of Socrative to enhance instruction in both undergraduate and graduate accounting courses and recommended using Socrative to promote student engagement through active learning. Guarascio et al. (2017) also found that students who used Socrative, compared to a traditional SRS method, were more engaged and facilitated an environment where asking questions was encouraged. Pryke (2020) shared similar findings where 74% of sociology students reported on a questionnaire that they enjoyed using Socrative and 84% believed that the application contributed to their knowledge on the subject. However, not a single study explored the impact of using Socrative in a distance learning course and not a single study exclusively compared the use of Socrative with an interactive PowerPoint game on student learning outcomes using an active learning approach.

IMPLICATIONS

In response to RQ1, elearners in the interactive PowerPoint game group clearly performed better on the posttest compared to elearners in the Socrative group. The difference in posttest scores between the two groups was statistically significant ($p < .05$). It is clear that playing interactive PowerPoint games are more effective than playing game-based SRS tools such as Socrative. Therefore, the null hypothesis can be rejected and there is evidence to support the alternative hypothesis. From an instruction and learning perspective, the instructional effectiveness of the interactive PowerPoint game is stronger than that of Socrative. However, using Socrative and interactive PowerPoint games as a game-based epedagogy for elearners is novel. Therefore, further studies are needed to draw accurate conclusions about their usefulness in distance education courses. The study finding also contributed to the conceptual framework that technology, pedagogy, and content knowledge are interconnected and can have an impact on teaching effectiveness and student academic performance regardless of education level, course, or subject matter (Koehler & Mishra, 2009; Mishra & Koehler, 2006). In addition, the findings contributed to the conceptual framework in that it guided me in designing, implementing, and evaluating game-based epedagogies for the purpose of promoting active learning in an online philosophy course.

RECOMMENDATIONS FOR PRACTICE

The first recommendation for higher education

leadership is for academic leaders to encourage the use DGBL as an approach to teaching and learning in undergraduate classrooms. Many empirical studies have shown positive benefits in using DGBL to gamify the learning experience in courses such as calculus (Lee et al., 2016), general education (Chang et al., 2017, 2018), and language learning (Erhel & Jamet, 2016; Hung et al., 2018). Therefore, DGBL methods may be useful in other courses, both in traditional and online learning modalities. The second recommendation for higher education leadership is to encourage the use of game-based epedagogies as a formative assessment for promoting active learning. The use of digital games or online games or quizzes to evaluate teaching effectiveness and student learning outcomes in traditional and blended college classrooms has been shown to significantly improve student learning outcomes (Badia Valiente et al., 2016; Karaaslan et al., 2018; Sanchez et al., 2020). In addition, using Socrative and interactive PowerPoint games can be an effective pedagogical approach for undergraduate courses in traditional classrooms; however, little is known about its effectiveness in distance education courses (Karaaslan et al., 2018; Squire, 2019). Therefore, further studies are needed to address this gap.

RECOMMENDATION FOR FUTURE RESEARCH

My recommendation for future research is to conduct a quasi-experimental study with a between-groups design to determine the causality of these differences in learning outcomes for interactive PowerPoint games in other undergraduate academic disciplines in both traditional and online modalities, such as nursing (Aljezawi & Albashtawy, 2015), medical student education (Brinley Rajagopal et al., 2020; Courtier et al., 2016), information literacy instruction (Shen, 2018), journalism (Bullard & Anderson, 2014) and accounting (Moncada & Moncada, 2014). Findings from these academic disciplines showed significant results in promoting active learning, enhancing student learning, and improving teaching effectiveness. The past research supports this recommendation as various active learning strategies and game-based assessments have shown varying benefits and drawbacks, and to understand what each game offers is vital for implementing the most effective elearning and teaching pedagogy (Badia Valiente et al., 2016; Chang et al., 2018; Karaaslan et al., 2018; Lee et al., 2016; Sanchez et al., 2020).

LIMITATIONS

This exploratory study has limitations. First, the results are limited to elearners enrolled in a first-year distance education course designed for diverse learners at a single institution. Second, a larger sample size would increase the power to detect statistical differences. Third, test scores were not tied to the student's response to the formative assessment. Future studies might identify whether or not the student's response to the formative assessment made a difference on their test score. Future studies also might examine whether the effect of games intervention differs by gender. Identifying students by gender might determine whether games are especially effective with male vs. female students.

CONCLUSION

The purpose of this quasi-experimental study was to examine differences in posttest scores based on game-based epedagogy used to promote active learning in an online philosophy course designed for first-year learners at a four-year university in the Southwestern United States. The study results were limited to first-year learners enrolled in an online undergraduate course; yet, the results may be generalizable to similar populations. Therefore, future studies are needed to determine the effectiveness of game-based epedagogies on learning outcomes for students enrolled in distance education courses at all education levels, and a larger sample size may detect greater statistical significance.

The findings from this study show there are differences in summative scores based on game-based epedagogy used in an online philosophy course. The use of digital games or game-based SRSs are effective in traditional classrooms; however, little is known about their effectiveness in distance education courses. The recommendation for practice is for higher education leadership to encourage game-based epedagogies such as interactive PowerPoint games or other game-based learning methods for teaching and learning for distance education courses, regardless of the level of class or subject area. A recommendation for future research is to conduct a quasi-experimental study with a between-groups design to determine causality of differences in academic achievement for interactive PowerPoint games in other undergraduate academic disciplines in both traditional and online modalities.

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