Spring 6-14-2018

Examining Game-like Design Elements and Student Engagement in an Online Asychronous Course for Undergraduate University Students

Aysegul Gok

ACCEPTANCE

This dissertation, EXAMINING GAME-LIKE DESIGN ELEMENTS AND STUDENT ENGAGEMENT IN AN ONLINE ASYCHRONOUS COURSE FOR UNDERGRADUATE UNIVERSITY STUDENTS, by AYSEGUL GOK, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

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EXAMINING GAME-LIKE DESIGN ELEMENTS AND STUDENT ENGAGEMENT IN AN ONLINE ASYCHRONOUS COURSE FOR UNDERGRADUATE UNIVERSITY STUDENTS

by

AYSEGUL GOK

Under the Direction of Brendan Calandra, Ph.D.

ABSTRACT

Due to growing number of online university courses (Allen & Seaman, 2016; Picciano, 2015; Wladis, Wladis, & Hachey, 2014), this study examined whether game-like design strategies can be used to increase the quality of an asynchronous online course experience for undergraduate students. Student engagement is related to learning activities such as student-student, student-instructor, and student-course material interaction, as well as positive factors such as satisfaction, accomplishment, and active and collaborative learning (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006; Shea et al., 2010). While there is a growing body of literature that deals with using game mechanics in instructional design generally, less is known about how game mechanics can increase student engagement in an online, asynchronous, university-level course. The quasi-treatment design of this study allowed for the comparison of student experiences in two versions of the same asynchronous undergraduate course. Data were collected via an online survey of perceived engagement, LMS-supported analytics, and grades. This study

shows the current technology use of the students. The majority of students who participated in this study have been using the internet and computers for seven years or more. Based on this study, designers and instructors of online courses may consider using game-like hidden badges as a way to improve engagement in the asynchronous learning environment. Reward schedules, clues, reminders, and profiles could be essential for efficient implementation of game mechanics.

INDEX: Game-like design, student engagement, behavioral engagement, online asynchronous course

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by

Aysegul Gok

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Philosophy

in

Learning Technologies Division

in

College of Education and Human Development

Georgia State University

Atlanta, Georgia

2018

DEDICATION

This dissertation is dedicated to my family: Sevket Gok (Dad), Senay Gok (Mom), Gokhan Gok (Brother) and Harun Gok (Brother). Your presence and support gave me the strength to finish this journey. Gokhan, thank you so much being there for me when our parents needed. Harun, thank you very much motivating me and encouraging me in difficult times. Mom and Dad, thank you so much for your endless love and care.

ACKNOWLEDGEMENTS

I wish to thank my committee: Dr. Brendan Calandra, Dr. Lauren Marqulieux, Dr. Nick Sauers, Dr. Robert Hendrick, and Dr. Mike Law for their willingness to help me on my journey. This dissertation would not be possible without their support and input. I am sincerely grateful to my advisor, Dr. Brendan Calandra, whose expertise, understanding, and support made it possible for me to start and finish this amazing journey. Thank you for tirelessly giving your inspiring feedback and encouragement.

To my friends, thank you Sidney Alvite, Lisa Embrack, Dan Von Pasecky, Briana Jones, Derya Kici, Tugba Ayer, Remeka Turk, Erica Bass, Brichaya Shah, Pelin Ozluk, and Tiffany Hightower thank you for listening, offering me advice, and supporting me through this process. Without your support, completing this dissertation would not have been possible.

Finally, my deepest appreciation for my parents and my brothers. They have always been a steady support and encouragement.

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CHAPTER 1: INTRODUCTION

1.1. Introduction

This study is designed to explore whether or not a treatment online asynchronous course has a greater impact on students' behavioral engagement compared to the same online asynchronous course that has not been gamified. The study used a quasi-treatment design that combined an end-of-course survey of perceived engagement with participant log entry data as measurable outcomes.

Online education is developing rapidly across higher education in the United States (Wladis et al., 2014). The Babson Survey Research Group has evaluated the scope of online education for the last 10 years (Allen & Seaman, 2015), finding that around one third of college students take at least one course in which approximately 80% of the course material is delivered online (Allen & Seaman, 2015). The U. S. Department of Education conducted a survey with approximately 4,900 higher education institutions; this survey showed that in 2013 about 26% of all students (at bachelor's, master's, and doctoral levels) took at least one course online, and about 11% received all of their education online (Bakia, Shear, Toyama, & Lasseter, 2012).

Online courses are delivered with different designs. Most online undergraduate courses are accessible asynchronously (McPherson & Bacow, 2015). Due to the flexibility of online education and the growing population of online students, online course quality and the support of online student learning is an essential issue for researchers (Akyol & Garrison, 2008; McPherson & Bacow, 2015). As shown in Figure 1, there are many factors that can affect course quality—and thus student learning—in online higher education: social presence, interactivity, community experiences, learner motivation, and student engagement (Bharuthram & Kies, 2012; Shea et al., 2010).

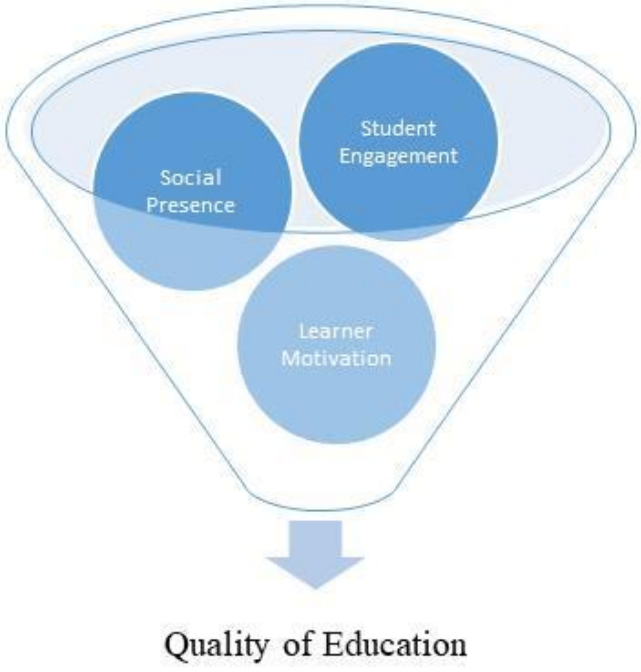

Figure 1. Some Variables Influencing the Quality of Education

The central constructs in this study are students' behavioral engagement, game mechanics, a gamified course, and game-like hidden badges. Behavioral engagement refers to the amount of active and observable learning as well as students' participation in learning procedures. I aimed to observe and improve the engagement between the students and their peers and course materials. Behavioral engagement improves students' participation such as involvement in extracurricular activities and avoiding dropping out (Fredricks & McColskey, 2012). According to the literature, developing and promoting students' behavioral engagement is vital in online learning. Encouraging student behavioral engagement can have a positive relationship with students' success (Kehrwald, 2008; Tinto, 2004; Riemer, & Schrader, 2016). Engaged students perceive learning as meaningful, and they are advanced in their learning and career. Student engagement improves learning, requires time and effort, and can be achieved for all learners (Christenson, Reschly, & Wylie, 2012). Learner engagement can result in developing

critical thinking skills, promoting higher grades, and encouraging responsibility to achieve goals (Riemer, & Schrader, 2016). In some cases, due to a lack of engagement between learners and instructors, as well as among learners, some students tend to feel isolated and disconnected (Haefner, 2000; Hughes, Ventura, & Dando, 2007; Slagter van Tryon & Bishop, 2009). Given the benefits of students' behavioral engagement, I focus in this study on improving students' behavioral engagement as an important component of online course quality.

The central constructs in this study are students' behavioral engagement, game mechanics, a treatment course, and game-like hidden badges. Behavioral engagement refers to the amount of active and observable learning as well as students' participation in learning procedures. Also, I aimed to observe and improve the engagement between the students and their peers and course materials. Another central construct is game mechanics: using game approaches, elements, and mechanics in non-game environments such as schools or websites to improve the learners' experiences to reach desired outcomes (Kapp, 2012). I use the term "game mechanics" as Kapp (2012) defines gamification. There are several critiques related to the implementation of game elements via gamification and different definitions of the use of game elements such as gamification by different researchers. Therefore, I only use the term "game mechanics" throughout the paper to prevent this concept confusion with similar concepts such as gamification and game-based learning. A treatment course is one designed using game mechanics. In this study, the treatment courses refer to the placement of hidden badges related to students' successes; students earn badges that are converted to credit at the end of the course. Throughout this dissertation, the courses that are not gamified comprise the control group. Finally, game-like hidden badges refer to rewards with visual or textual cues and rules in this study (Hamari, 2013; Jakobsson, 2011; Raish & Rimland, 2016). This is similar to badges;

however, students are able to convert them to extra credit at the end of the semester. Since the game-like hidden badges in this study are similar to other types of badges, I include game mechanics examples from the literature where badges were implemented.

1.2. Statement of the Problem

Students' behavioral engagement not only helps students feel connected but also improves their productivity. Leners and Sitzman (2006) found that supportive learning environments contributed to students' productivity and learning. While students engage together, they spend more time in their learning (Young & Bruce, 2011). However, due to lack of human contact, student engagement may not be possible in online courses as much as in face-to-face courses (Siever & Troja, 2014), which limits the utility of online education (Bejenaro, 2008). Online education also requires students to be self-directed (Jones, 2013). In spite of the flexibility, the amount of work can be overwhelming (Jones, 2013). Online classes are still implementing pedagogical methods that have been in place for years (Stephens, Feinberg, & Zack, 2013). The courses often are text heavy, requiring a lot of reading and writing. While educators move learners away from passive learning, there is not an effective solution for creating an online social learning environment (Gee, 2007). Students quickly feel that they are powerless, bored, and isolated in online classrooms (Jones, 2013; Siever & Troja, 2014). This demonstrates the need for a clear framework, including higher levels of engagement, for online education.

One strategy for increasing engagement in online learning is via game mechanics. Game mechanics have been growing in popularity as a teaching strategy for the few last years due to the improvement of the game design industry and social media. Quality game mechanics are successful by engaging players in a challenge that is defined by rules, includes interactivity,

supports creativity and problem-solving, gives autonomy to users, and provides feedback (Kapp, 2012). Overall, the quality of online education could be improved via student engagement and game mechanics.

1.3. Purpose of the Study

Game mechanics such as challenges, rewards, and fun might help students engage with the course content, their peers, and instructors in an online class, since the literature shows that game mechanics are a powerful tool to engage learners with their peers and activities (Charles, Bustard, & Black, 2008; Dillenbourg, 1999; Kapp, 2012; Lee & Hammer, 2011; Prensky, 2006; Salen & Zimmerman, 2003; Werbach & Hunter, 2012). This study tested if game mechanics including game elements such as game-like hidden badges in the treatment group would be more engaging or not when compared to the control group. I sought to validate this assumption through a quantitative study. In this study, I particularly examined the impact of this design on students' behavioral engagement in online education to contribute to the existing literature. This study is designed to support future studies of game mechanics in higher education as well as to inform educators who are interested in adopting particular game elements within their specific higher education settings, content, and educational goals.

Specifically, the research was guided by the following question:

- Do game-like hidden badges have an impact on students' behavioral engagement in an asynchronous online university course?

1.4. Rationale for the Study

Student engagement is a well-known topic in education, and there are many research studies on behavioral engagement in online education (Axelson & Frick, 2011; Darensbourg &

Blake, 2013; Heddy, 2014; Sinartra, Seli, & Mukhopadhyay, 2013). However, this study is significant for the reasons below.

- A review of literature shows no evidence of research on how game mechanics can increase student behavioral engagement in an online, asynchronous, university course.
- This research helps to implement a new strategy of game mechanics by including hidden game-like badges and converting them to course credit in order to improve students' behavioral engagement. This might give a different perspective on online education.
- The findings of this research enhance the body of knowledge and literature concerning using game mechanics in online learning environments.

This study is worthwhile to improve students' behavioral engagement due to the benefits of game mechanics and the learning theories and models such as Social Cognitive Theory, Goal Setting Theory, and the Community of Inquiry Model (see Figure 2).

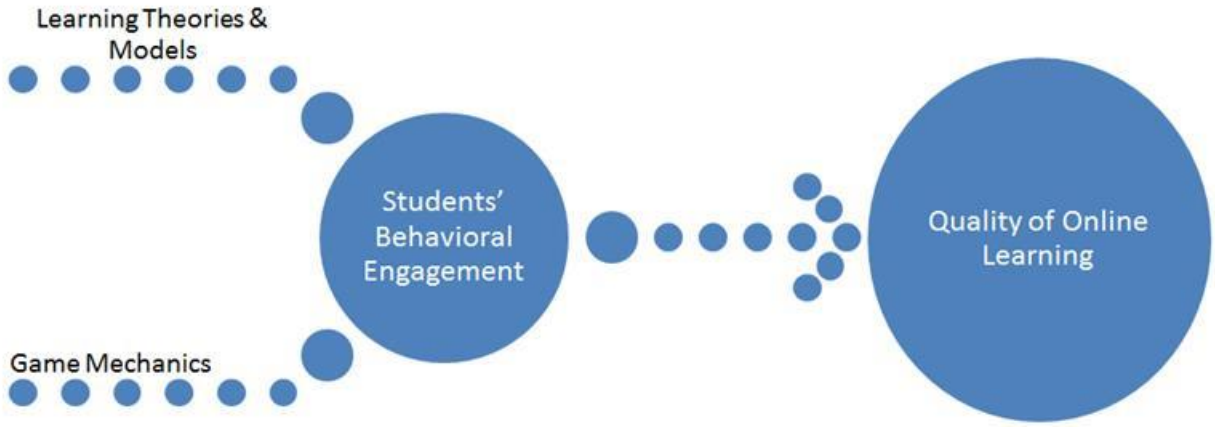

Figure 2. Rationale for the Study

The inclusion of gaming experiences in learning environments raised interest in providing more engaging experiences (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2015). Positive outcomes demonstrated in existing studies are a good motivator to continue to work on

game mechanics. For instance, students are inspired to complete tasks when they wish to receive rewards (Werbach & Hunter, 2012). Through game mechanics, people feel like active participants in the process, because they can use their skills and improve themselves on the targeted behavior, both online and offline, for real-world situations (Niculae & Duda, 2015). Game mechanics and students' behavioral engagement have a common outcome: improving learning. Chen, Lambert, and Guidry (2010) utilized the National Survey of Student Engagement (NSSE) student survey with another survey by the RAND Corporation and found a positive relationship between learning outcomes and student engagement.

Students' behavioral engagement is observed or is assumed to have an influence on learning (Fredricks, Blumenfeld, & Paris, 2004; Willms & Willms, 2003). Better academic outcomes for students are attributed to participating in collaborative learning activities online (Northey, Bucic, Chylinski, & Govind, 2015). Students who frequently use the online learning system to access materials have better assessment and exam results in open-access courses (Atherton et al., 2017). Kuh (2003) also emphasized the importance of student engagement in class and out of class in their success. Game-like hidden badges may help students engage with the course content and their peers, and student engagement might lead to better learning outcomes.

In this study, I focus on behavioral engagement due to the importance of behavioral engagement as demonstrated in the literature; research in behavioral engagement is essential for school success (Darensbourg & Blake, 2013). Also, based on my own teaching experience, I understand that there can be limited behavioral engagement in asynchronous online classes. Course outcomes may improve with the improvement of behavioral engagement in the

interactions between peers, between learners and course materials, and between students and the course instructor.

1.5. Overview of the Study

I attempted to understand the differences in students' behavioral engagement by using quasi-treatment research design and game mechanics through an online survey and log entry data in multiple sections of an online asynchronous undergraduate course at a large urban university in the southeastern United States. I attempted to understand and improve the students' behavioral engagement. In the treatment group, the students completed various learning activities supported by game-like hidden badges. Overall, the treatment group included game elements of rewards, tasks, and game-like hidden badges.

After reviewing several approaches, I chose a post-positivist research paradigm. In the study, quasi-treatment research was employed; a treatment research methodology was appropriate to accomplish the aims of the study. The quasi-treatment research design helped me predict relationships between variables and answer the research question. The sample was selected non-randomly for practical reasons such as the accessibility of the sample including a treatment and control group. It includes formed comparison groups instead of randomization (Gribbons & Herman, 1997).

CHAPTER 2: LITERATURE REVIEW

This chapter is a review of the current literature on engagement and game mechanics in online learning in higher education. The purpose of this review is to situate this study in the academic literature.

2.1. Engagement

The Handbook of Research on Student Engagement (Christenson et al., 2012) defined engagement as a student's active participation in school-related activities and dedication to his or her educational goals and learning. Axelson and Frick (2011) divided student engagement into three categories: cognitive, behavioral, and emotional. Cognitive engagement refers to intellectual effort that students spend in learning including learning goals, students' intrinsic motivation, self-regulation, and abilities to implement strategies. Behavioral engagement refers to the amount of active learning and student participation in the classroom and learning procedures. Emotional engagement refers to the investment and emotional reactions including student interest, identification, and positive attitudes or values about the learning process.

Pittaway and Moss (2014) created the Engagement Framework to explain how students engage. It offers five non-hierarchical dimensions of engagement: personal, academic, intellectual, social, and professional. However, I followed the engagement framework by Axelson and Frick (2011) and focused on the behavioral engagement in online education due to the importance of the behavioral engagement, as demonstrated in the literature, and the necessity of improving student engagement in class, as observed in my own teaching experience.

The literature shows that students' behavioral engagement is strongly related to supportive atmosphere, students' motivation, collaboration, the use of online resources, students' interest and self-regulation, and feedback (Bakker, 2005; Bryson & Hand, 2007; Kahu, 2013;

Kuh et al., 2006; Schuetz, 2008; Sun & Rueda, 2012). I am interested in understanding and improving overall students' behavioral engagement (see Figure 3).

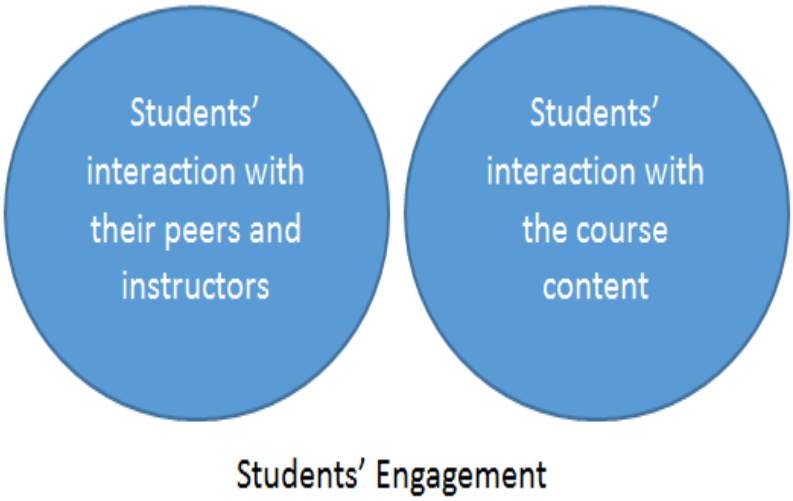

Figure 3. Main Components of Student Engagement

Majid, Yeow, Ying Audrey, and Shyong (2010) mentioned the importance of some learning activities in online education, such as responding to instructors' questions, looking for clarification and collaborating in team work (Shaw, Carey, & Mair, 2008), making a comment on discussion boards in order to improve engagement, and academic achievement (Maziha, 2010). Weaver and Qi (2005) reviewed limitations for active student engagement such as student preparation, student confidence or fear, and class size. For students to share their ideas or their experiences and interact with their peers, a safe and equal learning environment is required. Many studies focus on understanding factors that have an impact on students' participation (Crombie, Pyke, Silverthorn, Jones, & Piccinin, 2003); there are few studies on the techniques, patterns, and levels of student participation in learning environments. Course content depends on course structure, design, and format (Su, Bonk, Magjuka, Lui, & Lee, 2005). Students' behavioral engagement with course content refers to the time spent with course materials such as

course books, PowerPoint, and web pages (Su et al., 2005). However, students' behavioral engagement with course content has not been a focus in the research (Zimmerman, 2012).

Game mechanics improve the interaction between students and their peers, instructors, and course material. Overall, students' behavioral engagement helps to build a sense of community by sharing personal experiences, cooperating in instructional and social interactions, participating in class discussions, and exchanging resources (Shackelford & Maxwell, 2012). I aimed to develop these factors such as supportive atmosphere in class, engagement between the students, and interaction with the course content via game mechanics. The next section explains how these factors related to students' behavioral engagement can be improved by game mechanics.

2.2. Game Mechanics

In this and the following sections, I explain my understanding of game mechanics, the literature related to how game mechanics improve students' behavioral engagement, other game elements that were used in the research, and finally, the risks of game elements in order to design the game mechanics effectively.

My understanding aligns with the literature review done by Deterding, Dixon, Khaled, and Nacke (2011). Deterding et al. limited game mechanics to the game elements that represent games, including abstract and non-abstracts levels such as badges, leaderboards, time, and collaboration. Another perspective, by Werbach and Hunter (2012), divides game elements into three groups—dynamics, mechanics, and components—that are also divided based on levels of abstraction. Like Werbach and Hunter's framework, the Mechanics-Dynamics-Aesthetics (MDA) framework divides game elements into three components: mechanics, dynamics, and aesthetics. Game aesthetics are not tied to the learning materials; they are connected to emotions

that learners have via their experiences in a game such as narrative, challenge, discovery, achievement, or fantasy (Hunicke, LeBlanc, & Zubek, 2004).

I followed the Deterding et al. (2011) perspective on game elements primarily because of the simplicity of the categorization compared to other approaches; many approaches are still not significantly clear on categorizing game elements. Deterding et al. categorized game elements into two categories: game mechanics and dynamics. Game mechanics provide many activities and control mechanisms to allow user communication. Mechanics are the choices that designers use to specify the goals, rules, context, and interactions to be gamified. Some game mechanics may include point systems, badges, and challenges (Zichermann & Cunningham, 2011). These mechanics are clear before the game mechanics experience starts, and they stay the same throughout. Robson et al. (2015) defined three mechanics: setup, rule, and progression mechanics. However, I accept game mechanics as a unified concept including all the rules and structures from different parts of the game instead of following the three mechanics. Game mechanics determine what the main roles are, how people interact, what the rules are to win or lose, and where and when to play (Deterding et al., 2011).

Game dynamics have an important role in creating the desired outcome. Game dynamics form the types of player behavior within the gamified experience. The game dynamics let players progress by using the mechanics that could define in-game behaviors and interactions that merge during play (Camerer, 2003). Game mechanics such as group play can result in dynamics like cooperation, while an individual player may cause a more competitive environment (LeBlanc, 2004). However, game mechanics alone are not enough to motivate learners to reach desired outcomes. I aimed to design a course where game mechanics and dynamics would work together to improve the students' behavioral engagement.

2.3. Game Mechanics as a Solution

The applications of game mechanics are listed and explained below to show how game mechanics may help students engage in their learning environment. In the literature concerning the use of game elements in online classrooms, the focus on game elements is concentrated on motivation, on achievement (An & Bonk, 2009), and on the goal of making learning enjoyable and interactive (da Rocha Seixas, Gomes, & de Melo Filho, 2016; Reeves & Read, 2009).

Coursera and edX (Mamgain, Sharma, & Goyal, 2014) as well as Udacity (Williams, 2014) stated the reason that enrolled students are not retained throughout their courses is primarily due to the absence of motivation and interactivity, as well as feelings of isolation (Khalil & Ebner, 2014). Vaibhav and Gupta (2014) designed an environment for analyzing the differences between gamified and non-gamified MOOC platforms, resulting in a 28% increase in student retention in a gamified course compared with the non-gamified version of the course, with 79% of enrolled students finding improvements in their learning outcomes.

Game mechanics include a clear and moderately challenging problem (da Rocha Seixas et al., 2016; Deterding & McCarthy, 2012). Therefore, students work to solve problems continuously. These problems and this interactive work promote learners' 21st century skills such as critical thinking and collaboration (Awwal, Alom, & Care, 2015). Students feel better, improve their interest (Frost, Matta, & MacIvor, 2015; Pettit, McCoy, Kinney, & Schwartz, 2015), and reach their goals (Chou, 2015). For instance, getting an award during the game play should be a great feeling.

Browne, Anand, and Gosse (2014) found that including game elements in adult literacy education via educational software improved the students' behavioral engagement. They incorporated badges including green and gold check marks as rewards for successful practice and

levels at each submenu that provide objectives. The study design included short-term goals by earning an individual green check mark, medium-range goals by earning a gold check mark for a submenu, and long-term goals by earning all of the gold check marks. Within the study, goals as game elements in adult literacy education—via educational software—improved the students' behavioral engagement (Browne et al., 2014).

Domínguez et al. (2013) designed a gamified course for the students to receive rewards and medals. The students registered and uploaded their avatar. Fifty-eight students participated in the treatment group. The course that did not include game elements included PDF files. Students in the gamified course did better on the practical assignments and overall score (Domínguez et al., 2013).

As the literature above shows, there is a positive relationship between students' behavioral engagement and using badges or rewards for optional assignments and social learning activities such as playing a video game, collaborating with other learners, or making a comment (Browne et al., 2014; Denny, 2013; Domínguez et al., 2013, Hanus, & Fox, 2015; Hew, Huang, Chu, & Chiu, 2016; Mamgain et al., 2014; Niculae & Duda, 2015; Williams, 2014). In designing this study, I used game-like hidden badges, similar to the given examples from the literature, including optional assignments and badges within a complex social learning structure of short and long-term goals. However, I call these "game-like hidden badges" instead of badges or rewards since the design is similar to both but covers both by providing visual clues, rules, and credits at the end of the semester.

The examples above from the literature show different designs of badges such as achievement badges or badges for optional activities (Browne et al., 2014; Hanus & Fox, 2015; Hew et al., 2016). Since I focus on improving students' behavioral engagement and the students

receive grades for their assignments, I continued to review the applications of the badges for learning activities. Hew et al. (2016) used game elements (points, badges, and leader board) to design a Designing Questionnaire course that 11 students attended. The students selected a topic out of six different questionnaire topics and had a list of optional readings on the course content, categorized into easy, medium, and harder topics and rewarded one, two, and three points respectively. Students designed questionnaires, discussed them in an online discussion, and examined other groups' questionnaires. The instructor provided feedback on the students' questionnaires. Within this study, game mechanics improved the students' participation in the discussion and engagement with more difficult tasks. Students also stated that they enjoyed using the game mechanics design (Hew et al., 2016).

These examples above show the use of the tasks, badges, rewards and the positive relationship with students' behavioral engagement and learning outcomes (Browne et al., 2014; Goehle, 2013; Hew et al., 2016). These positive relationships between game elements and students' behavioral engagement encouraged me to design badges to be given based on students' performance of learning tasks. However, I went one step further by providing game-like hidden badges instead of implementing the same game mechanic as these studies. The use of game-like hidden badges is supported by Goehle's (2013) study. Goehle created levels and different types of achievements. For some achievements, students had to answer optional questions. For another type of achievement, students had to succeed in solving a homework problem. Lastly, hidden achievements were not seen by students until they were awarded. As a result of the study (Goehle, 2013), game mechanics in WeBWorK were successful to help students engage. Based on survey responses, the majority of students engaged with WeBWorK and expressed overwhelming enthusiasm for the system. Based on the literature review, I designed the study to

improve students' behavioral engagement including game-like hidden badges that were awarded when students accomplished assigned learning activities in an online asynchronous university course.

2.3. Major Game Elements in the Study

Game-like hidden badges include essential game elements such as rewards, tasks, interactions, fun, and challenges. These are explained below, including examples from the literature and the study design.

Rewards. Several websites track users' performance and engagement based on points, levels, and badges (Domínguez et al., 2013). Rewards could motivate learners to perform better with the learning material and with their peers in order to receive more rewards. Rewards could reflect a task performance or completion contingent (Deci et al., 2001) and may trigger intrinsic motivation or increase extrinsic motivation (Deci et al., 2001). Providing a reward to a new learner who is not interested in the subject may lead the player/student to start liking the content and shift motivations from extrinsic to intrinsic (Woolley, & Fishbach, 2018). Since rewards are given based on the consequences of the students' actions, these could be used or perceived as feedback. Therefore, I provided rewards via game-like hidden badges to incentivize the students to engage more. The game-like badges are differentiated based on the effort that is required of students to achieve different tasks. If students need to spend more time and effort they receive a game-like badge that is worth more credit than other tasks that do not require as much time or effort to accomplish.

Tasks. The integration of problems encourages learners to get motivated to learn the content (Voulgari, Komis, & Sampson, 2014). Prior research shows that the representations of the problem are essential for social learning environment (Mcgrenere, 1996). Tasks could

provide a positive learning environment if the learning environment encourages collaboration, discussions, and negotiation (Brown, Collins, & Duguid, 1989). I integrated learning tasks with rewards to encourage the students to engage with the course content and their peers. For example, if students provided feedback they received a game-like badge.

Interaction. Game design encourages participants to interact and communicate (Dillenbourg, 1999). Common goals and individual responsibilities create an effective social learning environment that encourages social relations, interactions, and behaviors. Within this study, the goal is helping students engage with their peers and course content. The students' goal is learning by interacting with their peers and the course content. For instance, in this study if a student interacts with his or her peers via discussion boards more than the required level of participation, a student receives a game-like hidden badge in order to encourage his or her participation behavior on the discussion board.

Fun. Fun as a game element supports the students' behavioral engagement through game play (Kim, Chen, & Zhang, 2016). The educational settings should enhance the fun naturally like the game settings in the reviewed articles. Game mechanics should be included fun experiences that expose learners to consistent sets of stimuli to guide and hide the learning flows (Gheorghe et al., 2017). The natural transition toward learning experiences where game elements are used along with other content reduces some of the barriers that learners may be facing. In educational settings, individual students may find fun in different types of activities such as challenges, problem-solving, and earning points. Since there is no clear path to design fun in educational environments, educators should provide different learning activities to be able to make learning fun. Technology is not enough to make learning fun. However, effective game design could make learning fun (Lerner, 2014).

When designing game mechanics, it is important to consider the implementation of motivating interactions, balancing fun and learning, and the construction of social features that can inspire learning and prevent social isolation driven by technology (Gheorghe et al., 2017). I aspired to make the game mechanics design fun by providing game-like hidden badges via learning activities. I provided extra credit by converting game-like badges that could be fun for students into points applied toward their final grade. Allocating points is one of the most popular game mechanics (Hsu & Wang, 2018).

Challenge. Challenge as a game element provides a fun experience for solving conflicts with or without time constraints. Challenge could be implemented differently in learning environments. For instance, a "circuit game" includes problems to determine circuit components and increase or decrease the speed of the circuit (Adams, Mayer, MacNmara, Koenig, & Wainess, 2012). During the circuit game, the students solve the problem to find the ideal speed of the circuit as a challenge in the course content. Another game was Murder on Grimm Isle (Dickey, 2011); the island has been evacuated, and agents have a limited time to collect evidence. In Murder on Grimm Isle, students collect evidence in a story as a challenge. The proper level of the challenges, including constraints such as time in the games, keeps learners' attention while learning the content. If learners are not able to successfully complete tasks due to the difficulty of the tasks or timing, learners might be frustrated and stop engaging with the learning content. That is why it is essential to provide appropriate resources for learners to engage. I had hoped to embed tasks of different difficulty levels—such as basic, medium, and difficult—for students to help them earn game-like badges and gain more credits compared to the basic tasks. However, the implementation of this design was not practical via the existing learning management system.

2.4. Risk of Game Mechanics

I not only reviewed the articles that found positive outcomes from game mechanics study designs, but also articles that were not able to reach the expected outcomes. In one example (Landers, 2014), students started at Level 1 (equal to a grade of F) and earned points by participating in learning activities such as giving presentations and taking quizzes and exams to achieve higher grades. Landers found no relationship between game mechanics and students' behavioral engagement. Changing the names of the course materials with game elements such as level and points is not enough to improve the course outcomes. Game mechanics are complex. When the game mechanics design is blended with other learning strategies such as social learning, the design was more likely to result in expected outcomes. Otherwise, game mechanics design might not provide quality learning environments. That is why I provided hidden badges as rewards to students based on their completion of a variety of learning activities.

Some critiques claim that game mechanics may not always hold attention and may decrease learners' motivation (Dickey, 2010) due to the inappropriate design of game mechanics like reward schedules or the use of leaderboards. The reward schedule is an important factor, like rewards, to change learners' behavior. For instance, an insufficient reward schedule would let learners focus on only scoring more points and winning the competition. On the other hand, if the design keeps rewarding learners regularly after their accomplishment, the environment may not be fun for the players once they understand the reward structure. It is important for learners to understand that the subject they are working on is not as difficult as it may seem. Also, they must enjoy working on the subject. Therefore, I used hidden badges, unseen by students until they were awarded. I also did not use leaderboards in the class setting and kept the class in its natural setting in order to avoid the gratuitous use of game mechanics.

2.5. Theoretical Framework

In the previous section, I explained engagement, the interdependent relationship between engagement and game mechanics, the major game elements that I implemented in this study, and the importance of designing game mechanics effectively. In this section, I intend to justify how game mechanics might aid with engagement in online learning through the theories. I explain how and why game mechanics are an efficient solution to enhance engagement by utilizing learning theories and the existing literature (see Figure 4).

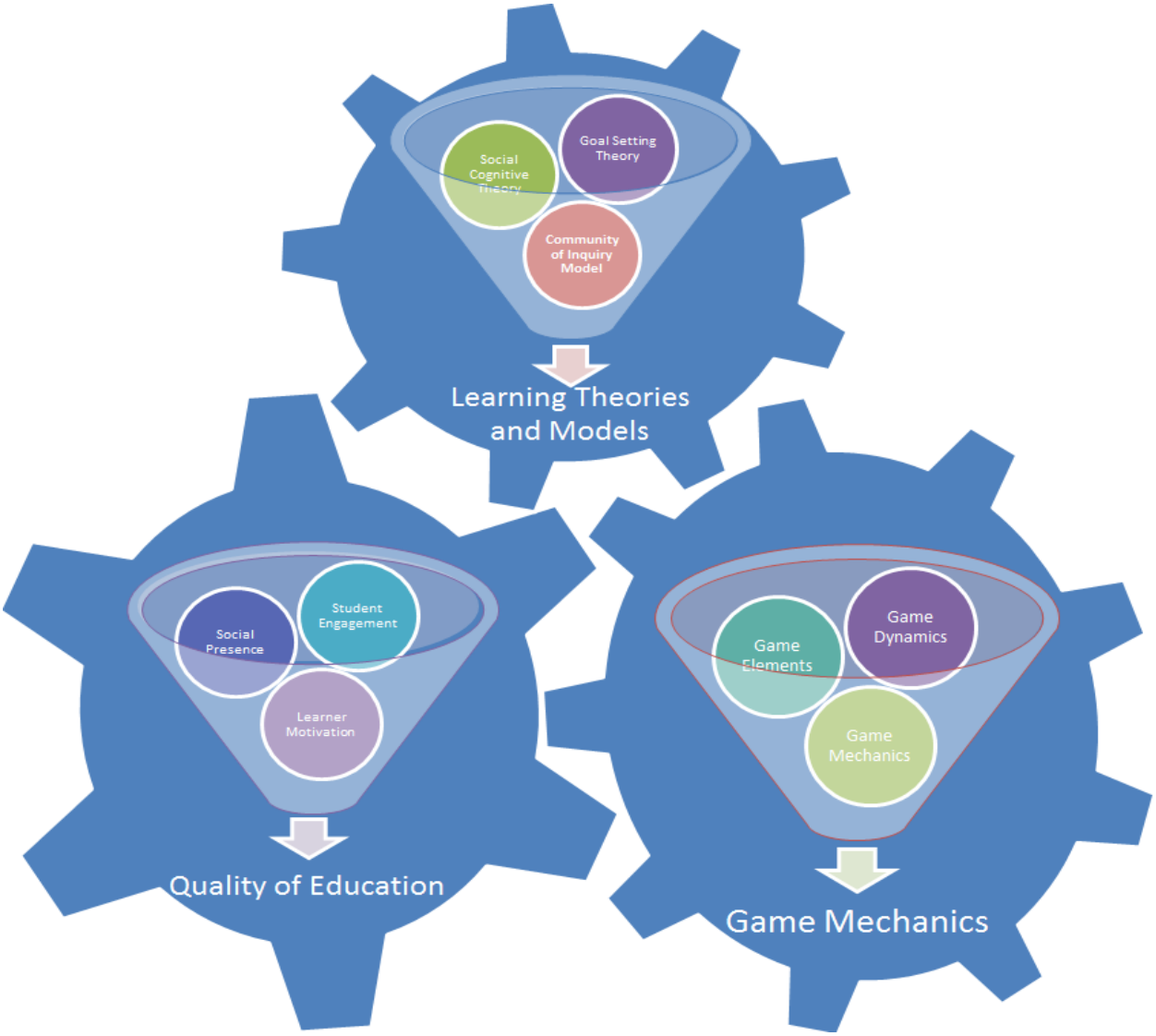

Figure 4. Theoretical Framework

Game mechanics, theories, and models—such as the self-determination, social cognitive, goal-setting theories, and the community of inquiry models—are vital to explain the relationship between game mechanics and learners' motivation to spend time and effort on content. Each theory explained below contributes to game elements and mechanics in order to develop students' behavioral engagement and the quality of online education. With the support of these theories, researchers can deliver specific content with a designed learning environment by choosing the appropriate game mechanics design to promote desired learning outcomes.

This study uses engagement, social, and game-based learning theories. The theoretical framework of the study is derived from the Social Gamification framework (Simões, Redondo, & Vilas, 2012) and the Input-Process-Outcome Game Model (Huang et al., 2014). The social learning was expected to support those contents and game mechanics. The Social Gamification framework aims motivate students to improve their skills with rewards and other incentives helps students to be closely connected to school. With the proper tools and access to data about students' progress the system or instructors can incent students more often and just after students' achievements (Lee & Hammer, 2011). The framework emphasizes the importance of helping students deal with anxiety when facing the chance to fail (Simões, Redondo, & Vilas, 2012). The framework helps to design the learning environment creating challenges based on the student's level of knowledge, providing multiple ways to achieve their objective, providing feedback or a reward.

Motivation theories are essential to help learners engage with learning content and activities via game mechanics. Due to the lack of face-to-face interaction, learners' motivation becomes the main part of successful online learning that requires students' behavioral engagement (Blumenfeld et al., 1991). Also, Yang, Tsai, Kim, Cho, and Laffey (2006) found a

positive correlation between motivation and social presence in online classes. Self-Determination Theory is a basis of the relationship between learners' motivation and rewards in game mechanics. Ryan and Deci (1981) explained intrinsic and extrinsic motivation based on the reasons or goals that motivate people to take an action. Intrinsic motivation emerges from a desire to learn, and extrinsic motivation emerges from gaining rewards, eliminating penalty, or decreasing tension (Hartnett, St. George, & Dron, 2011). Self-Determination theory explains the students' desire to gain game-like hidden badges and convert them to extra credits at the end of the semester.

In this study, the tasks assigned to receive game-like badges are detailed, measurable, realistic, time-limited, and challenging, since people are more likely to perform the best to achieve their goals, as outlined in goal setting theory (Locke, Shaw, Sari, & Latham, 1981). Game mechanics such as game-like hidden badges function as goal-setting tools by rewarding the completion or achievement of distinct goals (Gnauk, Dannecker, & Hahmann, 2012).

Since game mechanics include many components, social cognitive theory and the community of inquiry model (CoI) explain and support the requirement of the collective support from multiple participants in learning communities that are designed by game mechanics (Miller, 2013; Reed, 2008; Rogoff, 2003; Wenger, 1998). Social learning refers to practical learning such as participation, collaboration, and communication (Voulgari et al., 2014). Social learning, according to Bandura (1976), can be applied to teach new behaviors, to develop reactions, and to enable the adoption of certain behaviors. In this concept, learning occurs by observing others and is influenced by the results of the interactions and characteristics between the observer and the model. Game mechanics and game elements are motivated by a sociocultural perspective of learning (Guillén-Nieto & Aleson-Carbonell, 2012). By using game elements such as

collaboration, learners have a chance to observe and interact with their classmates in order to learn a new behavior or knowledge. Therefore, collaboration improves learning and its outcomes (Dillenbourg, 1999). Quality collaboration for learning includes well-organized participants, discussion, well-distributed cognition, and the learning space (Dillenbourg, Järvelä, & Fischer, 2009). Game-like hidden badges and the social learning activities to gain game-like hidden badges provide a standardized set of criteria and community standards (Halavais, 2012).

In the community of inquiry (CoI) model, the community and the members of the community shape each other toward mutual goals (Rogoff, 1998). CoI includes three levels: intellectual, social, and emotional (Sewell & George, 2008). The social level refers to the interactions between learners and course materials, as well as between learners and learners by developing interpersonal relations and a sense of belonging to the community (Chapman, Ramondt, & Smiley, 2005; Garrison, 2009). This theory supports the study through shaping of the course and the students in the course as whole. Since social learning occurs via constant interaction, it is essential that game elements become a part of and contribute to consistent student interactions. In order to be a part of the ongoing process of students' behavioral engagement, game mechanics may provide some features such as rewards and challenges (Medema, Furber, Adamowski, Oigi, & Mayer, 2016).

2.6. Summary of the Theoretical Framework

Overall, the learning theories above are related to the study directly and indirectly. However, goal setting, self-determination, social cognitive theories, and the community of inquiry model form the main framework due to the use of game elements and social learning activities in the study design. Other theories link to the study as a part of online course design principles. Each theory contributes to the course design and explains the appropriate use of the

game elements in order to improve students' behavioral engagement and the quality of online education. With the support of these theories above, I designed the online higher education course by choosing the appropriate game mechanics design to promote engagement and the quality of online education.

CHAPTER 3: METHODS

3.1. Introduction

The purpose of this study is to examine whether game-like design strategies increase student engagement in an asynchronous online course for undergraduate students. This study is meant to provide information to understand the impact of using game elements in online asynchronous courses. While there has been a significant increase in general game mechanics-related studies, there is still much to learn about the circumstances under which game mechanics can create positive change, and even less is known related to how game mechanics can increase student engagement in an online, asynchronous, university course. The course examined during this study is an undergraduate-level course designed based on international standards and competencies for teaching basic computer and information literacy. The treatment group included various game elements such as rewards, tasks, interactions, and game-like hidden badges. The control group included no game elements. I selected a quasi-treatment research design (Gribbons & Herman, 1997).

Table 1 presents more detailed information about alignment of the research question with methods and analysis.

Table 1

Alignment of Research Questions with Methods and Analysis

Research Question	Data Type	Data Analysis Used
Do hidden badges have an impact on student engagement in an asynchronous online university course?	Online Student Engagement Scale (OSE)	Descriptive Analysis *T*-test
	Log Entry Data • Total Time Spent in Seconds Weekly • Total Number of Discussion Posts • Time Spent in Seconds on Each Objective and Assignment • Number of Words from the Discussion Posts	Mann–Whitney U test Repeated Measures ANOVA
	Grade	Mann–Whitney U test

3.2. Data Collection

In this research study, I tested whether game mechanics and game-like hidden badges improve behavioral engagement in the online asynchronous course. The research (see Figure 5) involves the existing online student engagement scale survey and LMS-supported log entry data including: total time spent in seconds weekly, total number of discussion posts, time spent in seconds on each objective, time spent in seconds on each assignment, and number of words from the discussion posts. I converted the data collected in seconds to minutes to make it more understandable for readers. I assume that the log entry data helps show whether students engage with course content and peers. The survey data supports log entry data by demonstrating students' perception of their engagement in the course.

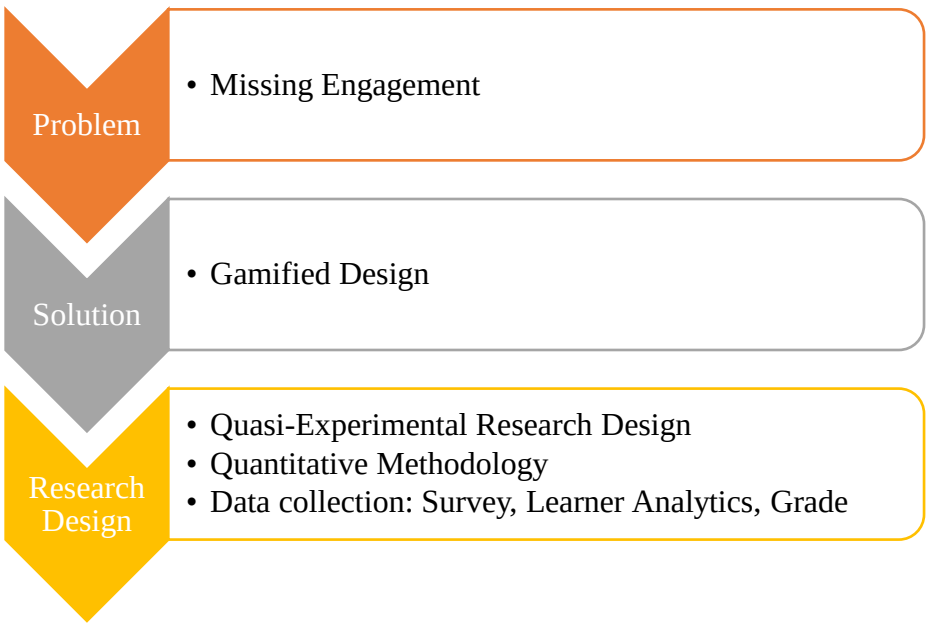

Figure 5. Summary of the Research Design

Students are not limited by place of participation; they could engage at any time or place. This study takes place within the students' natural learning environment, which necessarily differs from student to student.

3.2.1. Online Student Engagement Scale Survey

I selected the Online Student Engagement Scale (OSE; Dixson, 2015) since it is related to students' behavioral engagement in an online course. The survey used in this study was pilot-tested with 31 students in an online communication courses at a Midwestern university (Dixson, 2015). Dixson's scale indicated strong reliability (Cronbach's alpha = .95). Dixson tested and supported initial reliability and concurrent validity via the pilot study. However, 31 students are not nearly enough to be a validated measure. There are possible limitations of using this existing survey (i.e., the unvalidated accuracy of the instrument to measure the students' behavioral engagement), but using an existing instrument allowed me to collect data within the time constraints of the study.

This survey includes a Likert-type scale with five possible choices: (1) not at all characteristic of me, (2) not really characteristic of me, (3) moderately characteristic of me, (4) characteristic of me, and (5) very characteristic of me (Dixson, 2015). These are the same choices included in the original survey, the Online Student Engagement Scale (OSE).

I identified the dimensions of behavioral engagement and customized the survey based on the dimensions. See Appendix A for the customized survey. Behavioral engagement is defined as observable behaviors such as downloading assignments or taking a survey (Heddy et al., 2014). Behavioral engagement refers to the level of active learning and students' participation in classroom and learning procedures (Axelson & Frick, 2011). For instance, one of the survey items is "Participating actively in discussion forums." If a student rates "(5) very characteristic of me," I interpret this to mean the student perceived that the course supports his or her engagement in the course. These type of questions are easy and quick to answer and easy to compare with other respondents. However, the responses may not have the exact answer the respondent wants to give and, therefore, the response does not give information about whether or not the respondent actually understood the question being asked.

I removed the items not related to behavioral engagement from the existing survey. I removed some of the survey items (7, 8, 10, 13, 14, 15, 21, 22, 25) to fit the survey items to the course design and improve the face validity of the survey. For instance, some of the survey items were removed because the items do not apply to the nature of the course content. For example, "Doing well on the tests/quizzes" was removed since there were no tests or quizzes in the course.

The customized survey included 20 items to measure students' perceived engagement. Qualtrics Survey Software was used to disseminate the online survey; this tool allows me to

create multiple types of questions, to create a link to the survey on a website, and to compile the survey data.

3.2.2. Log Entry Data

In the analysis, I aimed to test the log entry data as predictors of the students' behavioral engagement in the treatment and control groups. This study uses five entry log variables, including the total time spent (in seconds) weekly, total number of discussion posts, time spent (in seconds) on each objective, time spent (in seconds) on each assignment, and number of words from the discussion posts (see Figure 6).

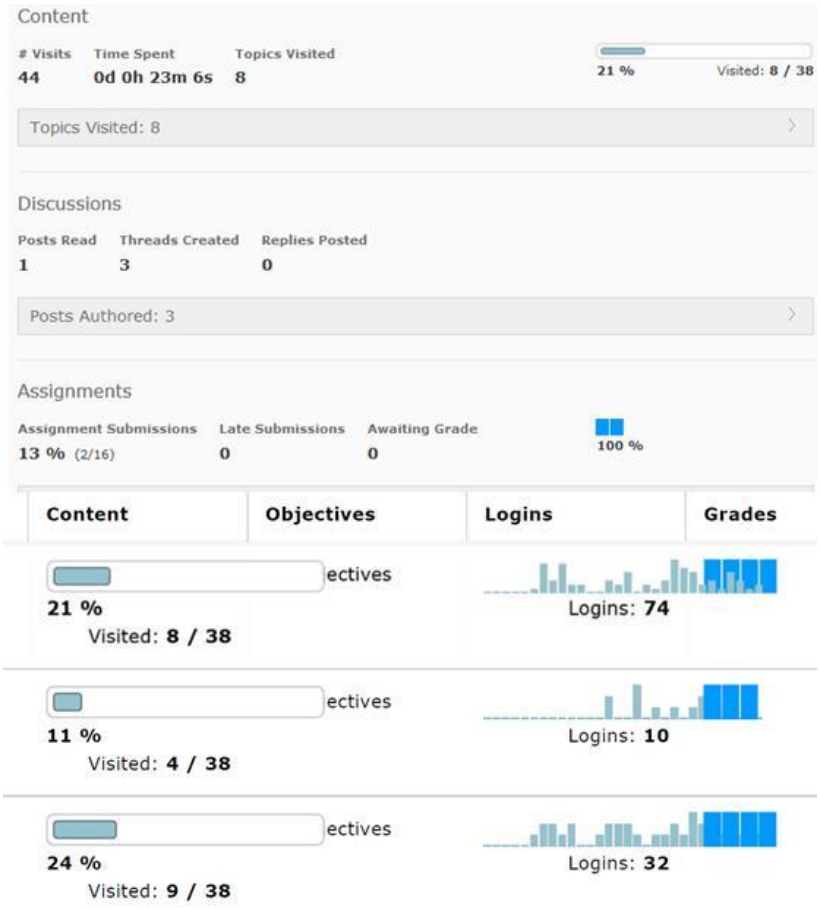

Figure 6. Screenshots of the Sample Log Entry Data

3.3. Sample

The sample of this study are undergraduate students enrolled in a course, *LT 2010 Computer Skills for the Information Age*, in a large state university in the United States during the fall 2017 semester. Each section of the course includes around 25 students. The students differ in terms of their major, ethnicity, gender, and economic background. All the students have some computer skills such as using emails and navigating the learning management system.

I utilized the convenience sampling technique to select the sample for the study due to the accessibility of the sample to me. However, I randomly assigned courses into two groups: treatment and control group. Power analysis and expected effect size were calculated to identify the appropriate sample size for the groups. First of all, I calculated the expected effect size utilizing similar research by Domínguez et al. (2013) who experimented using game mechanics in a university course that includes several modules such as word processor, spreadsheet, and presentation software. Instead of providing the course content as downloadable text files to the students, Domínguez et al. (2013) developed a Blackboard plugin and used the same exercises via gamification. Due to the similarities of the target group, content of the course, and study design, I found the moderate effect size (0.59) by using the means and standard deviations of the two groups in Domínguez et al.'s (2013) research (see Table 2). I used the expected effect size (0.59), which was realistic to expect from my research.

Table 2

Effect Size

	Treatment	Control
N	27	96
M	70.71	58.99
SD	15.52	23.43
Cohen's d	0.59	

The research used the effect size and G-power (http://www.gpower.hhu.de/en.html) to calculate the sample size. The study focuses on the relationship in both groups. I used a two-tailed test. Also, I selected "Means: Difference between two independent means (two groups)" due to the independence of the treatment and control groups. The sample size required for each the treatment and control group is reachable (*n*=47). I used the five sections of the course as a treatment group and the five sections of the same course as a control group (see Table 3).

Table 3

Sample Size

Input Parameters		Output Parameters	
Critical *t*	1.98217	Non-Centrality Parameter δ	2.86
Effect Size d	0.59	Critical *t*	1.9821735
A err prob	0.05	Df	92
Power (1- β err prob)	0.80	Sample Size Group 1	47
Allocation Ratio N2/N1	1	Sample Size Group 2	47
		Total Sample Size	94
		Actual Power	0.8079

3.4. Research Settings (Control Group)

The learning management system used in this study was Desire2Learn, which allows for conducting courses, keeping track of grades, providing feedback, and having a record of activities that occurred in the course. The course has been taught online, and it is offered three times per year. The program is not new, so student enrollment in this course is predictable. During fall and spring semesters, around six sections are offered. During summer semesters, two or three sections are offered. The study was planned during a fall semester. The class size is typically 25 students. The course was located in the school learning management system, Desire2Learn (D2L). The course—*LT 2010*—took place over 15 weeks and has 15 required weekly assignments and one project. Some of the topics for the course covered each week were Information Literacy, Word Processing, Cyber Ethics, Spreadsheets, Virtual Design, Digital

Presentations, and Web Design and Development. The instructors of the course provided students weekly feedback and grades on their assignments. Emails, feedback boxes, and discussion/forum postings were communication tools for the students. Students worked through the modules, as they were released each week, at a time and location that was convenient for them. There were no synchronous meetings requiring the learners to be online at a specific time or place, but they did have the schedule listed above and shown in the course syllabus (see Appendix D: Course Syllabus). The instructors were involved frequently through direct feedback on assignments and discussions. News or announcements posts were made multiple times per week to keep students informed of due dates and expectations; these announcements also often provided encouraging feedback to keep students motivated and engaged.

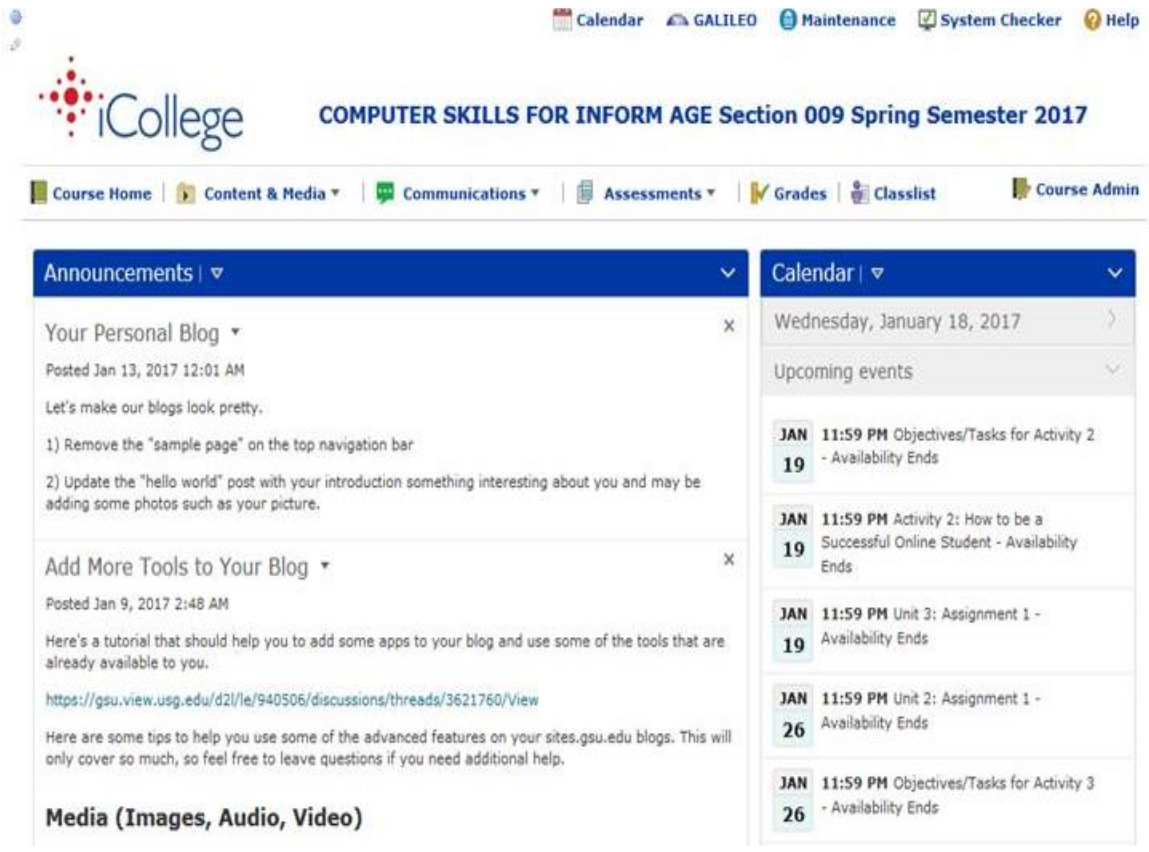

Figure 7. Screenshot of Desire2Learn – *LT 2010* Homepage

Some of the *LT 2010* courses were used as a control group, and some were used as a treatment group. Similar to the treatment group, students had one week for each assignment. The weekly activities were accessible on the first day of each week (see Figure 7). After seven days, the access to the activity was closed and the next activity started. Different from the control group, the treatment groups included nine game-like hidden badges for the completion of the learning activities via discussion boards, blogs, and assignments that challenge and reward the students.

3.4.1. Treatment Group

The explanations of the goals (to receive game-like badges), rules (of game-like badges), credits (when students receive badges), and game-like badges (how students will receive, and their badge will be reported) were provided via the course syllabus during the first week of study. Upon their completion of the learning activities, the students received a game-like badge. The learning activities were the same in both treatment and control groups. When students exceeded the learning expectations, they received badges in the treatment group. Overall, the course that the treatment group participated in included the following game elements: rewards, tasks, interactions, game-like hidden badges. Each student received one welcome message and potentially nine game-like badges when they completed the assigned tasks for the game-like badges.

Because the research took place in an online learning environment, there were primarily two options for giving game-like badges. The first was to use the D2L grading option. This option allowed instructors to provide feedback while grading an assignment. Students could see their grades and instructor's feedback in the same section, called a gradebook. However, gradebook shows their grades instead of a game-like badge. That is why using another channel to

inform the students about their extra points was helpful to keep the students from getting confused. Also, the students could not ask questions via gradebook if they had questions about the game-like badges. Therefore, email was the main communication channel to send the game-like badges and answer student questions about those badges. The other options for giving game-like badge could have been forum postings. However, it would have been difficult for the instructors to keep a record and convert the students' badge to a grade at the end of the semester.

3.4.2. Hidden Game-Like Badges

I designed hidden game-like badges for each week; this included the value of the badge and a graphic related to their success area (e.g., such as problem solving and collaborating) to send a student who completes the task required to receive a game-like badge. I designed a brief email to send a game-like badge to a student, because long messages could be difficult to read and comprehend.

A game-like badge was given for certain type of learning activities. I designed game-like hidden badges to improve students' behavioral engagement, as measured by utilizing the log entry data from the learning management system. For instance, students could comment on their friends' work. The student who provided the most feedback received a game-like badge. If a student listed different tools and the tools in the book on their tool inventory, he or she received a hidden game-like badge. The student who posted to their blog the most in class received a hidden game-like badge. Other students did not know who receive the hidden badges unless they talk in class due to keeping the students' grades private. There might be a chance that students guess their peers' grades if they know the number of hidden badges they receive since most badges were given due to the outstanding achievement on their assignments.

There were a total of 15 activities during the 15 weeks. Each week included different topics and activities. These activities were required for students to receive their regular grade. Besides those activities, the students received another task to collect a game-like badge for extra credit each week. Every week, the instructors in the treatment group checked the students' responses for the assigned task of the game-like badges and emailed badges to the students who completed the assigned task (see Appendix G). At the end of the semester, instructors converted game-like badges to extra credit using the gradebook. In order to ensure that the game-like hidden badges were awarded consistently between instructors, I met with instructors and prepared concrete directions including the tasks and the requirements of the tasks to be accomplished and communication template with the students for the game mechanics process. See Table 4 for sample hidden badges, the tasks required to receive hidden badges, and the credit the participants can gain when they receive a badge. To see the full list of the badges, see Appendix C.

Table 4

Sample of Hidden Badge Chart

Graphic	A Brief Email	Task	Credit
	Hello (name)! I just wanted to congratulate you on achieving your hidden badge! Feel free to email me anytime if you have any questions or want some support! Your badge is worth 0.2 points. Continue collecting!	Students exceed the assignment's expectation via the U2A1.	0.2
	Hey (username)! I just wanted to drop by and say congratulations on your awesome new hidden badge! It's an amazing achievement. I hope you feel proud of yourself and recognize how much you're doing. Keep being you and keep being awesome! Your badge is worth 0.2 points. Continue collecting!	Students compare Justfacts and Factcheck and analyze CRAAP extremely well and in detail.	0.2
	Hi there, (insert name here). I noticed you just received a new hidden badge, how awesome is that?! You should be very proud of yourself! Keep up the good work and don't hesitate to email me with any question! Your badge is worth 0.2 points. Continue collecting!	Students exceed the assignment's expectation via the U4A1.	0.2

3.5. Data Analysis

This type of post-positivist research setting uses quantitative analytical techniques, such as statistical analysis. Both descriptive analysis and inferential analyses (Green, 2013) were used to determine the relationship between the means of the survey scores of the participants in the differing treatment groups and other software tools. *T*-test and Mann-Whitney U test analyses were used to understand if there is statistical evidence that the two sample means (treatment and control groups) are significantly different.

The log entry data helped me to identify how students were engaged in the design during or after implementation for a more holistic perspective of the impact of learning activities. The log entry data such as the total time spent (in seconds) weekly, total number of discussion posts, time spent (in seconds) on each objective, time spent (in seconds) on each assignment, and

number of words from the discussion posts was gathered by the university system and analyzed by me (Bienkowski et al., 2012). The last step of the data analysis process was to interpret the findings and provide recommendations. When drawing conclusions, I reviewed and summarized the findings looking for similarities and differences between the treatment and control group.

The survey data was downloaded from Qualtrics Survey Software and exported to the Statistical Package for the Social Sciences (SPSS) Version 21 software for analysis. SPSS was used to compute and analyze data for frequencies, means, and standard deviations. Descriptive statistics were collected to understand characteristics of the sample with the survey (see Appendix B). The analyses of the log entry data, survey data, and grade data were based on the statistical significant differences and correlations between the treatment and control groups (Agudo-Peregrina, Iglesias-Pradas, Conde-González, & Hernáandez-Garcia, 2014).

CHAPTER 4: FINDINGS

4.1. Data Preparation and Screening

The purpose of this study was to determine whether using the game-like hidden badges in an asynchronous online course had an impact on student engagement. Treatment and control groups were compared based on grades, survey, total time spent weekly, total time spent on each objective, total time spent on each assignment, total number of discussion posts, and number of words in discussion posts. The data were collected during the Fall 2017.

To answer the research question, several steps were performed before the analysis began such as verifying accuracy and identifying outliers and missing responses. Seven data sets from the treatment and control groups were used to examine the impact of game-like hidden badges: survey data, grades, total time spent weekly, total time spent on each objective, total time spent on each assignment, total number of discussion posts, and number of words in discussion posts. After organizing and cleaning the data, the comparison between the treatment and control groups was made utilizing existing literature and statistical analysis.

A single master course design including the same course schedule and content was used for the duration of one semester. The badge guideline was provided to the instructors who taught the treatment group (see Appendix E). The purpose of the study and procedure including the template messages and rules to provide the game-like hidden badges in the course content were explained via the badge guideline. The guideline has supported the objectivity of the instructors.

Understanding the distribution of the data was the first step of the statistical analysis. I determined whether the data are parametric or non-parametric based on the distribution of the data. If the data were distributed normally, I analyzed the data as parametric; otherwise non-parametric tests were used, as outlined in Table 5.

Table 5

Parametric and Non-parametric Tests

Group	Grade	Engagement Score	Time Spent	Discussion Post
Treatment	Non-parametric	Parametric	Parametric	Non-parametric
Control	Non-parametric	Parametric	Non-parametric	Non-parametric

The *t*-test was used for the parametric distributions, and Mann-Whitney U test was used for the non-parametric distributions. The results from the *t*-test and Mann-Whitney U test analyses allowed me to proceed under the assumption that the treatment and control courses were the same, regardless of which section or instructor facilitated the course.

4.2. Data Cleaning

I used a box plot to identify outlier, and I removed students from the data analysis using the IQR rule as a criterion. Two participants in the treatment group were observed as outliers while I was analyzing the grade data, and one participant in the control group was identified as an outlier (over 1 hour) in the LMS data.

Data cleaning included the examination of the total time spent and the total number of discussion posts. Total time spent is the sum of the time (in seconds) students spent working on tasks related to course content. Students have a week to complete a particular learning task (Martin & Whitmer, 2016). The total time spent is cumulatively calculated. If a student spends one minute on a task and next day he/she opens the same page again and spends another one minute on that task, the total time spent is two minutes on the content.

In order to clean the time spent data, I removed some minus one values during the data screening stage. The LMS does not begin recording time spent on a task until the page has been fully loaded. If a student had accessed content but clicked the back button in their browser or closed the browser before the page could fully load, the LMS generated a minus one value for

that session. The minus one value indicates that the student selected the link to access the content (whether intentionally or unintentionally), but did not spend any time on the page, hence these data were removed.

Given that page loading times and lag can vary depending on internet connection and/or device, it is difficult to determine the exact amount of time a student spent on content between page load and page close. This could occur in situations such as mobile device access with a lower-speed internet connection or on a computer that does not have high-speed internet access. My assumption is that pages load and close very quickly and that there is a positive value in the LMS for time spent on the content.

There are additional ways the accuracy in the time spent data can be impacted. One way this can occur is when more time is logged in the LMS than was actually spent accessing content. For instance, if a participant loads page content and leaves the room, that time period is logged in the LMS. This is time that the participant was not engaged in the content, and hence should not be time counted toward total time spent.

Another way that time spent data can be impacted is when time spent on content is not logged in the LMS. For instance, a participant loads page content, prints the course material, closes the page, and then proceeds to study the course content offline. The time spent printing the course material was logged in the LMS, but the actual time spent on content by the participant was not being logged. In such cases where no data were available as to how much time was actually spent on course content offline, I accepted the remaining time spent values as is.

4.3. Hidden Badges

See Table 6 for the distribution of game-like hidden badges sent by the instructors of the treatment groups.

Table 6

Distribution of Game-like Hidden Badges

Group	Badge 1	Badge 2	Badge 3	Badge 4	Badge 5	Badge 6	Badge 7	Badge 8	Badge 9	Total
1	3	5	4	13	16	18	21	17	17	114
2	7	2	8	2	3	13	6	7	11	59
3	13	5	4	2	5	10	5	17	19	80
Total	23	12	16	17	24	41	32	41	47	253

4.4. Characteristic of the Sample

The demographic data from the survey included gender, race, age, class, major, and the use of the internet. In Fall 2017, there were five sections of the course used for this study. Three sections of the course were designed for a treatment group, and the other two sections of the course were used in a control group. In Fall 2017, 89 of the 106 students enrolled in *LT 2010* consented to participate in the study at the beginning of the semester, for a participation rate of 84% (see Appendix F). However, 59 of 106 students participated in the study for an overall response rate of 55.7%. Thirty participants who consented to participate in the study did not respond to the survey, resulting in a lower response rate than originally anticipated. Since those 30 students did not respond to the survey, they were removed from the study even though they consented to participate. See Table 7 for the distribution of participants between the treatment and control groups.

Table 7

Distribution of the Participants

Group	Number of Students	Number of Participants	Percentage of Participants
Treatment	63	31	49.2%
Control	43	28	65.1%

See Table 8 for the distribution of the students based on their majors.

Table 8

Distribution of the Students by Major

Major	Number of Students
Computer Science	12
Exercise Science	9
Film/Media/Video	11
Interdisciplinary Studies	8
Kinesiology	5
Journalism	7
Sport Administration	7
Spanish	5
Theater Design and Technology	5

The participants in this study were mainly sophomore, junior, and senior students, with ages between 18 and 24. There were almost no differences between the number of female and male participants in this study (see Table 9). The course was skewed senior (40.68 %), predominantly African American (57.6 %), and largely between the ages of 18-23, which is typical for undergraduate courses.

Table 9

Characteristics of the Sample

	Overall Sample	Treatment Group	Control Group
	59	31	28
Gender			
Female	33	20	13
Male	26	11	15
Race/Ethnicity			
White	9	4	5
African American	34	19	15
Asian	13	7	6
Other	3	1	2
Age			
Under 18	1	0	1
18-23	43	21	22
24-26	8	5	3
Over 26	7	5	2
Class			
Freshman	1	1	0
Sophomore	7	6	1
Junior	26	13	13
Senior	24	11	13
Other	1	0	1

Table 10 outlines the participants' prior experience with internet use. Of the participants, 3.8% indicated that they had been using the internet between four and six years. The rest of the participants indicated that they had been using the internet seven or more years. Overall, the sample has enough prior experience to be comfortable with the technology used in class.

Table 10

Internet Use

	Overall Sample	Treatment Group	Control Group
7 years or more	96.2%	31	41
4 to 6 years	3.8%	1	2
1-3 years	0	0	0

94.7% of the participants use the internet daily from their home. Only 3.4% of the participants indicated that they never use the internet at home. The participants mainly use the internet from home, school, and work as shown the bars for overall on Figure 8 below. See Figure 8 for data on daily internet use.

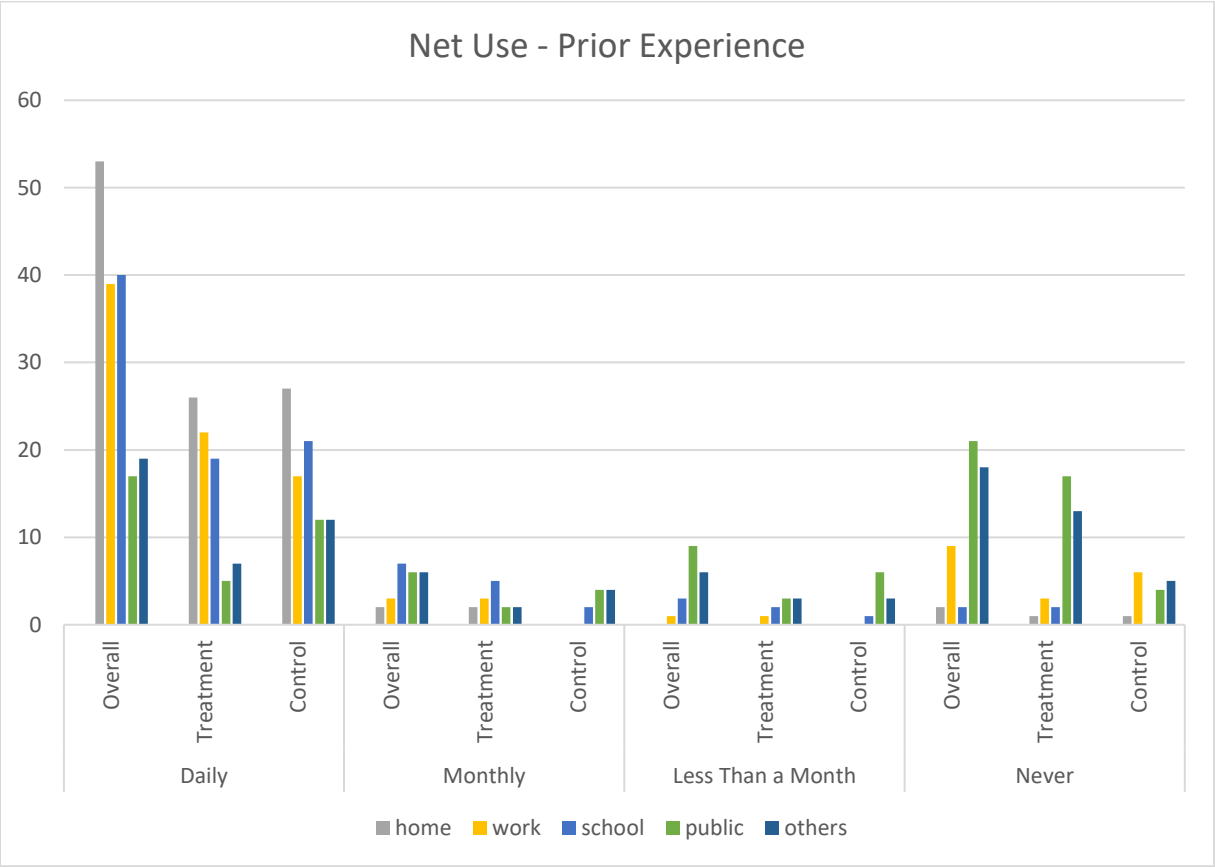

Figure 8. Daily internet use

4.5. Online Engagement Scale Survey

See Figure 9 for the distribution of the mean of the survey items between the treatment and control groups.

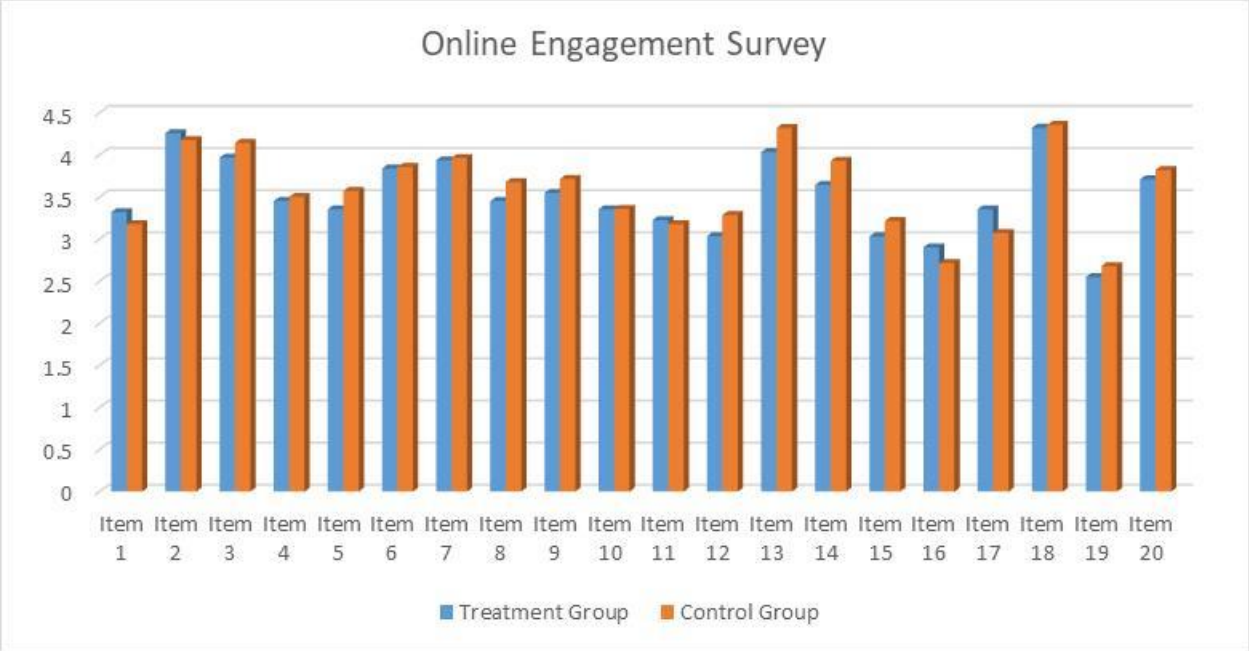

Figure 9. Distribution of the Average of Survey Items

The mean of the engagement score in the treatment and control groups are 70.80 and (SD=15.098, SEM=2.757) and 71.15 (SD=10.276, SEM=1.978), respectively; the maximum engagement score is 100 in both groups. However, there are no statistically significant results (t (55)= -.101, p=.920). The reliability of the survey was calculated at .920. See Table 11 for the survey items including their means and p values.

Table 11

Analysis of the Survey

No	Survey Item	Treatment Mean	Control Mean	*p* Value	t (55) Value
1	Making sure to study on a regular basis	3.37	3.19	.532	.629
2	Putting forth effort	4.27	4.15	.528	.634
3	Doing all the homework	4.00	4.11	.636	-.476
4	Staying up on the readings	3.50	3.50	.837	.207
5	Looking over class notes to make sure I understand	3.40	3.44	.709	-.375
6	Being organized	3.93	3.85	.779	.282
7	Entering the online class multiple times a week	3.90	3.92	.939	-.076
8	Applying course material to my life	3.43	3.67	.443	-.772
9	Finding ways to make the course interesting to me	3.57	3.70	.642	-.468
10	Visiting or calling the instructor about the course	3.40	3.37	.923	.097
11	Participating actively in discussion forums	3.23	3.15	.775	.287
12	Helping fellow students	3.03	3.26	.441	-.777
13	Getting a good grade	4.13	4.30	.432	-.792
14	Taking advantage of all class resources	3.70	3.93	.357	-.930
15	Engaging in conversations online	3.07	3.19	.680	-.414
16	Posting in the discussion forum regularly	2.90	2.67	.435	.787
17	Emailing the instructor regarding my grade in the class	3.37	3.07	.314	1.016
18	Checking my grades online	4.30	4.37	.764	-.301
19	Getting to know other students in the class	2.57	2.63	.840	-.202
20	Assessing my own learning and progress in the class	3.73	3.81	.752	-.310

I reviewed the relationship between the engagement score and the grade in both groups. The mean of the grade is 91.93 and the mean of the engagement score is 70.96 in the control group. There is a significant relationship between the engagement score and the grade in both groups (r=.317, n=58, *p*=.016). The mean of the engagement score is 70.80 and the mean of the grade is 90.65 in the treatment group. There is a statistically significant relationship between the engagement score and students' grades in the treatment group (r=.367, n=30, *p*=.046). However, there is no statistically significant relationship between engagement score and students' grades in the control group (r=.185, n=28, *p*=.356).

4.6. Time Spent

In this study, the time spent and discussion post data were logged over a 12-week period, which accounted for the entire duration of the implementation of game-like hidden badges. The overall total time spent findings do not include the first week of the course, since students only accessed materials to understand the nature of the course—including the assignment start and end dates—and determined expectations for the course. Hidden badges were implemented in the second week, and applicable badges were awarded beginning in the third week. Finally, the last two weeks of the course were not included in the time spent data to give some time to the instructors to convert the badge credit to the final credit. See Figure 10 for the distribution of the total time spent in minutes on content each week during the process of achieving game-like hidden badges.

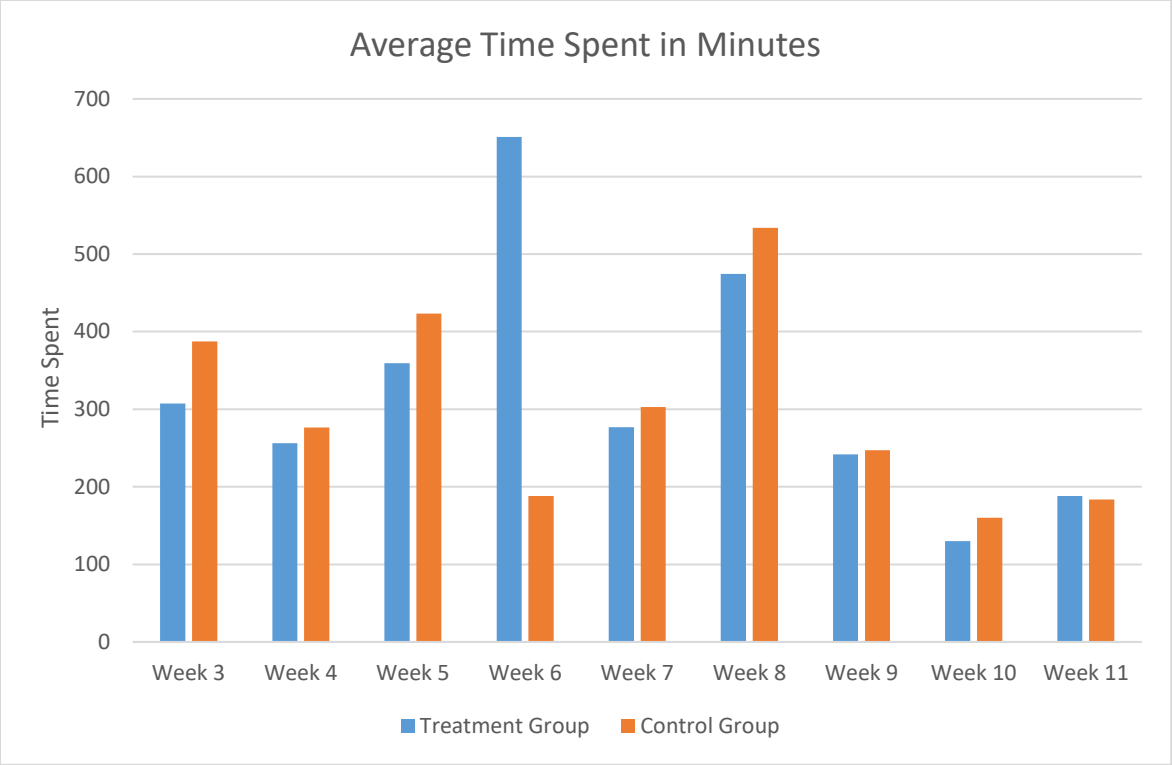

Figure 10. Distribution of Time Spent

The course content includes two different types of pages for each unit, Objectives and Assignments. See Figure 11 below for the distribution of time spent on objectives.

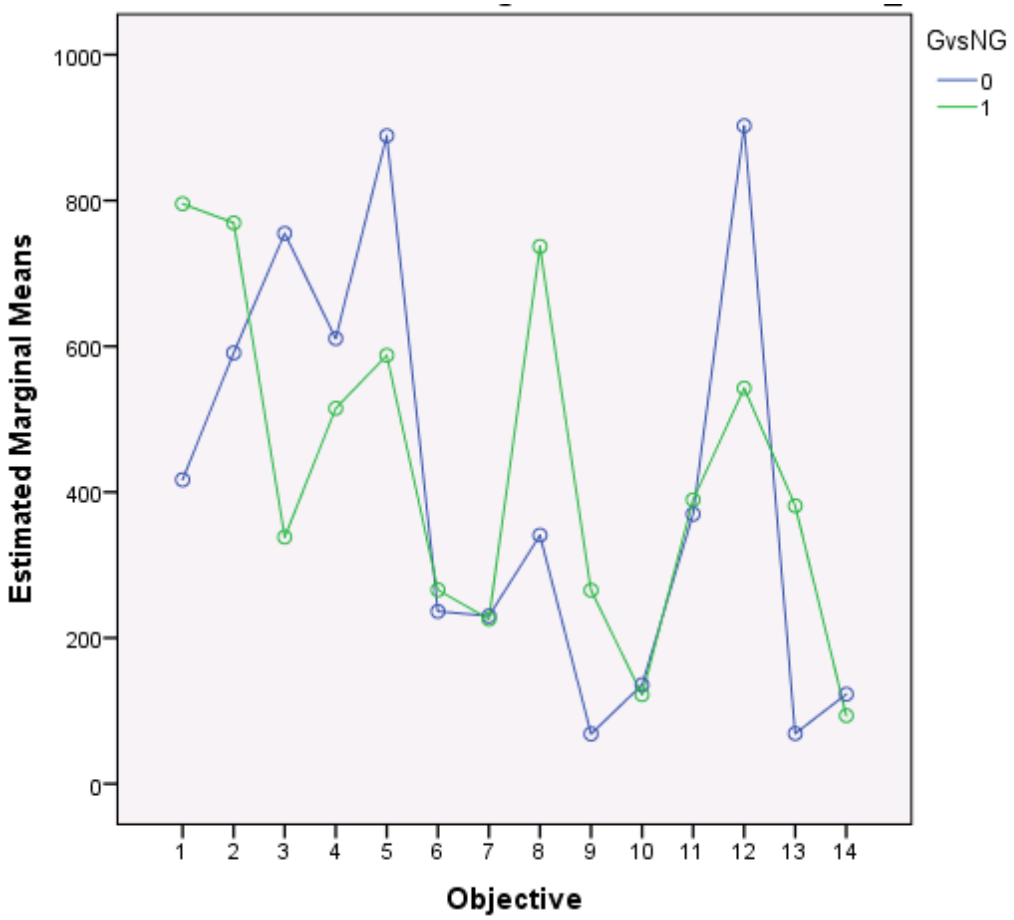

Figure 11. Distribution of Time Spent on Objectives

This section of the analysis involved the repeated measures ANOVA. I ran two repeated measures ANOVAs, one for the objectives and one for the assignments. Mauchly's test indicated that the sphericity assumption is violated for objectives (p=.001) and assignments (p=.000). The adjustment for Greenhouse-Geisser is used to correct for the violation of sphericity since Greenhouse-Geisser estimate of the sphericity values are less than .75 for the objectives (ε= .566, and .674) and for the assignments (ε= .191 and .210). Using this correction, F(7.359, 404.726)= 1.702 is not significant for objectives because its p value is .056, which is greater than the normal criterion of .05 (see Table 12). F(3.633, 199.797)= 3.803 is significant for the assignments

because its *p* value is .007, which is less than the normal criterion of .05. See Figure 12 for the estimated means of the assignments.

Table 12

ANOVA Results

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
The difference between the means of the treatment and control groups' assignments	Greenhouse-Geisser	15794491.955	3.633	4347907.214	3.803	.007

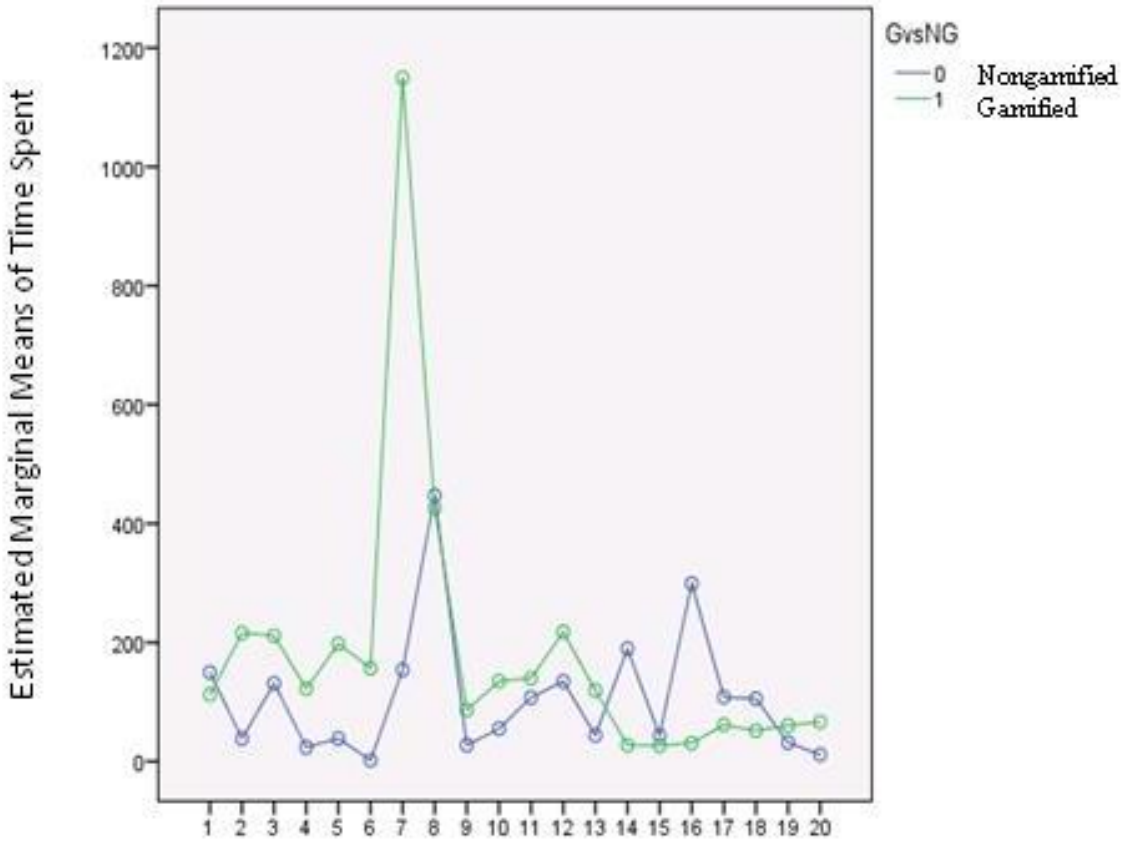

Figure 12. Estimated Marginal Means of the Assignments

4.7. Number of Discussion Posts and Total Number of Words in the Discussion Board

Since the only statically significant content between the treatment and control group was week 6 (Unit 5 Assignment 1), I reviewed the Unit 5 Assignment 1, which is a discussion board activity ,to understand the possible reasons and causes of this difference. The mean of the total number of discussion posts for Unit 5 Assignment 1 (M = 6.428571) in the treatment group is greater than the mean of the total number of discussion posts for Unit 5 Assignment 1 (M = 6.296296) in the control group. See Figure 12 for the differences of the time spent between the two groups on the assignments throughout the semester.

To investigate the reasons behind the statistically significant difference in total time spent between the treatment and control groups on week 6 [F(3.633, 199.797)= 3.803, p=.007] at the $p<.005$ level, I analyzed the number of posts and words on the discussion board activity, Unit 5 Assignment 1. The mean of the time spent in minutes (M = 172.79) in the treatment group is more than the mean of the time spent (M = 157.58) in the control group (see Table 13).

Table 13

Average Time Spent and Number of Discussion Posts on Unit 5 Assignment 1

Group	Average Time Spent in Minutes	Average Number of Discussion Posts
M Treatment Group	172.79	6.428571
M Control Group	157.58	6.296296

There were no statistically significant differences in the number of the discussion post on Unit 5 Assignment 1 between the treatment and control groups t(56)=.235, p= .815. In order to see the possible reason for the statistically significant difference in total time spent between the treatment and control groups on week 6 [F(3.633, 199.797)= 3.803, p=.007] at the $p<.05$ level, I

analyzed the word frequency assuming if there is a difference in use of the language it might lead to spend more time in the treatment group.

See Table 14 for the first 16 words used the most in the discussion posts between the two groups. The type of words, including nouns, verbs, and conjunctions and frequency of words, were similar. For instance, the average of "can" and "like" per person is two and one in both groups, irrespective of the topic of the discussion activity.

Table 14

Word Frequency

Treatment Group		Control Group	
Word	Average	Word	Average
information	5.44	information	5.76
can	1.94	online	1.90
online	1.79	can	1.80
privacy	1.76	privacy	1.61
like	1.41	like	1.47
internet	1.32	internet	1.09
Spokeo	1.32	personal	1
people	1.29	Spokeo	1
think	1.20	people	0.95
personal	0.85	available	0.85
protection	0.82	legal	0.80
find	0.82	believe	0.76
social	0.79	social	0.76
even	0.79	think	0.76
available	0.76	websites	0.66
legal	0.76	name	0.66

I reviewed readability statistics to understand the difference in total time spent between the two groups on Unit 5 Assignment 1. I assumed students may spend more time reading and writing text if it is difficult to read. Readability statistics are presented in Table 15. The score fell in the 10th- to 12th-grade level for what the participants wrote in both groups, which is defined as fairly difficult to read in both groups.

Table 15

Readability Statistics

Readability	Treatment Group	Control Group
Flesch Reading Ease	53.7	54.8
Flesch-Kincaid Grade Level	10.8	10.6
Passive Sentences	21.1%	19.7%

The number of the words in both groups were not distributed normally, and there was an outlier in the treatment group (removed by me before applying a non-parametric test, Mann-Whitney U test). The *p* value is .15151 (U=358.500). The result is not significant at $p < .05$.

I stratified survey, total time spent, and grade data by treatment/control group. I found several statistically significant results as explained previously in this section. There is a statistically significant difference in time spent on the week 6 assignment (Unit 5 Assignment 1) between the treatment and control groups. I reviewed the relationship between the engagement score and the grade in overall sample (r=.317, n=58, *p*=.016) and in the treatment group (r=.367, n=30, *p*=.046).

CHAPTER 5: DISCUSSION

5.1. Introduction

Behavioral engagement refers to the amount of active and observable learning and students' participation in learning procedures (Axelson & Frick, 2011). The literature shows that students' behavioral engagement is strongly related to collaboration between students and students, interaction between students and instructors, and the use of resources (Kahu, 2013; Sun & Rueda, 2012).

I conducted this study to examine students' behavioral engagement and to understand if game-like hidden badges have an impact on students' behavioral engagement in an asynchronous university course. Several quantitative data collection methods were used in gathering data from students, including the Online Engagement Scale survey; LMS-supported analytics data such as total time spent weekly, total number of discussion posts, time spent on each objective, time spent on each assignment, and number of words in discussion posts; and grades. To understand differences in students' behavioral engagement between the treatment and control groups, outliers were removed following proper procedure, and the *t*-test and Mann-Whitney U test were used depending on the distribution of the data sets such as the online engagement scale survey, grade, and LMS-supported analytics data. Also, the repeated measures ANOVA was used to understand consistencies between the treatment and control groups.

5.4. Treatment and Control Group

The study results include three subsections including results from different datasets such as survey, LMS data, and grade. The rationale for categorizing is to have a better understanding of the impact of game-like hidden badges and compare the differences between the treatment and control groups.

5.4.1. Online Engagement Survey Results on Overall Sample

There were no statistically significant differences between the participants' perception of behavioral engagement in the treatment and control groups as a result of the online student engagement survey. This result shows that the hidden badges might have no impact on the students' perception in the treatment group since the participants in both groups perceived they were engaged in class.

I found a statistically significant relationship between the engagement score and students' grades in the treatment group (r=.367, n=30, *p*=.046) but found no statistically significant relationship between the engagement score and students' grades in the control group (r=.97, n=28, *p*=.356) or between the students' behavioral engagement score and total time they spent in the treatment group (r=.066, n=27, *p*=.730). Engagement score might be a good predictor of grade and may not be a good predictor of the total time spent in treatment group. Hidden badges might support students' self-efficacy on their grades.

5.4.2. Time Spent Data Results on Overall Sample

I divided the time spent data into three groups: the mean of the time spent on weekly content including weekly objectives and assignments, the mean of the time spent on each objective, and the mean of the time spent on each assignment, while analyzing the data for overall participants. The repeated measure tests were applied using time spent data. Time spent has an extensive range and standard deviation, showing that some students spent a long time while others spent less.

There is a statistically significant difference on time spent on the week 6 assignment (Unit 5 Assignment 1) between the treatment and control groups. I explain this increase with the awareness of the hidden badges. The participants could be fully aware of the hidden badges by

week 6 and could have been spending more time trying to achieve them, because they had started receiving hidden badges during week 3, 4, and 5, which gave them a chance to become aware of the hidden badges and to experience achieving them. Until week 3, the treatment group had not received any hidden badges. This was done to let students get comfortable with the course content first. The participants likely understood that when they spend enough time and exceed the expectations of the assignments, they receive a hidden badge for each assignment.

Reward schedule is one of the essential factors to change the participants' engagement in the online environment. Many tasks to receive a hidden badge were embedded into the assignments. The participants in the treatment group did not spend enough time to create a statistically significant difference for the rest of the course duration.

The treatment group spent more time than the control group on Unit 2 Assignment 1, Unit 2 Assignment 2, Unit 3 Assignment 1, Unit 3 Assignment 2, Unit 4 Assignment 3, Unit 5 Assignment 1, Unit 6 Assignment 1, Unit 6 Assignment 2, Unit 7 Assignment 1, Unit 8 Assignment 1, Unit 10 Assignment 1, and Unit 10 Assignment 2. This shows that the participants in the treatment group spent more time overall on the assignments.

Finally, the number of the badges they received increased significantly between weeks 5 and 9. One possible explanation for this is that the participants were interested in receiving extra credits via hidden badges to improve their final grades instead of asking the course instructor about opportunities to improve their final grades.

5.4.3. Grades Results on Overall Sample

Domínguez et al. (2013) designed a gamified course that included 36 challenge achievements and seven participation achievements for the students to receive rewards and medals. As a result of the study, the students in the treatment group got better scores in practical

assignments and overall score. However, in the current study, I found no significant difference in aspects of the students' grades between the treatment and control group (r=-.110, n=58, *p*=.229).

Course grades were used as the data set to measure student performance. There was very little dispersion in weekly grades in either course, which is common in these courses. I was not able to find any significant differences between students' grades, engagement scores, and total time spent. I found no significant relationship between the students' total time spent (r=.039, n=58, *p*=.260) in the treatment group and control group in this study.

5.4.4. Discussion Post Results on Overall Sample

Studies explore different part of discussion boards such as the characteristics of discussion posts and their relationships with intersubjectivity (Lim, Jeong, Hall, & Freed, 2017), group structures, and organization (Johnson et al., 2017), student engagement through social learning analytics, and theme analysis (Chen, Chang, Ouyang, & Zhou, 2018). Kim et al. (2016) stated that the mean number of words in posts would be a good indicator of the quality of the answers. The mean of the discussion posts (M=6.428571) for the Unit 5 Assignment 1 in the treatment group is higher than the mean of the discussion posts (M=6.296296) for the Unit 5 Assignment 1 in the control group (U=362, *p*=.916). The mean of the words that the participants in the treatment group used is more than the mean of the words in the control group used. However, there were no statistically significant differences between the two groups related to the number of words used.

5.4.5. Conclusion

This study resulted in some meaningful conclusions about game mechanics, specifically, game-like hidden badges in online asynchronous computer-skills course. There is a statistically significant difference on time spent on the week 6 assignment (Unit 5 Assignment 1) between

the treatment and control groups. I reviewed the relationship between the engagement score and the grade in both groups (r=.317, n=58, *p*=.016) and in the treatment group (r=.367, n=30, *p*=.046). The time spent data played a significant role in determining the students' behavioral engagement in this asynchronous learning environment. The survey data could be used to predict student grades on asynchronous courses.

5.5. Implication

These findings have the following implication for those teaching online courses as well as those who design online courses:

- Game-like hidden badges may have an impact on students' behavioral engagement in asynchronous learning environment.

The implication applies only to this particular environment disqualifies it from being an implication for others to use. In this following section, I discuss how each of this implication may affect online students' behavioral engagement in asynchronous learning environment and compare it with existing literature. Finally, I show how the implication may contribute to knowledge in the field.

5.5.1. Implication – Game-like Hidden Badges and Student Engagement

Designers and instructors of online courses may consider implementing game-like hidden badges as a factor that may promote students' behavioral engagement in asynchronous learning environments. There is a statistically significant difference in time spent on the week 6 assignment (Unit 5 Assignment 1) between the treatment and control groups [F(3.633, 199.797)= 3.803, *p*=.007] at the *p*<.005 level. This increase may be because of the use of the hidden badges.

Rewards, in this case hidden badges, may be given continuously or on a variable schedule (Skinner, 1938). One of the primary goals of using game-like hidden badges was to use variable

rewards. Variable rewards occur when a response is rewarded after an unpredictable amount of time has passed; it is distinct from a continuous reward schedule where rewards are distributed at a predetermined rate or schedule. Students might be least interested in receiving continuous rewards. Hidden badges as continuous rewards might not keep students engaged with the course and their peers regularly.

Some research suggests that game-like designs could undermine intrinsic motivation for players initially interested in a subject (Wu, 2012). Unexpected non–task-contingent rewards such as game-like hidden badges could be used without undermining intrinsic motivation in a learning environment. For instance, a Speed Camera Lottery experiment provided rewards to drivers who obeyed the speed limit. In the Speed Camera Lottery experiment, people might not drive at the given speed limit if the potential for winning a lottery does not exist, although the game mechanics may improve extrinsic motivation for people to follow the speed limit. Because the motivation is extrinsic, behavior may not change permanently, and old behavior may return due to the lack of reinforcement.

5.6. Limitations

The data in this research came from 106 students taking *LT 2010* as an online asynchronous course at a large research university in the southeastern United States. The study outcomes might be affected by many variables besides game mechanics. For instance, the existence of uncontrolled variables could include the number of students enrolled, the nature of the student population, and different instructors teaching the various sections of the course. In an attempt to reduce the impact of this limitation, I created email templates and provided an information session including all instructors at the beginning of the course to discuss and to ensure that game mechanics were being implemented consistently between instructors.

Another limitation of the data collection is the possibility of students printing out the materials rather than reading them online, affecting the measurement of reading time. Time spent reading material offline is not accounted for in the learning management system. These problems might be improved using additional measures. There could be an opportunity to improve the accuracy of the amount of time that students spend on different learning tasks via automatic logout times. Another limitation of time spent data is related to the nature of the course, which required uploading files. It is a challenge to force students to implement every task on the LMS or merge other online activities with the LMS to improve the accuracy of the time spent data.

The survey was self-reported. The analysis of the survey was based on students' perceptions, leading to the possibility of interpretive errors by the responders. The survey questions were closed-ended questions that provided a limited set of response options. Although the resulting data may be helpful in quantitative analysis, including open-ended questions in the future would provide an opportunity for more in-depth responses (Mierzw, Souidi, & Savel, 2016).

The study design was limited to the instructors' efforts to implement the hidden badges. Another area for improvement might be providing customized student profiles so that students can track their progress, the number of the badges they receive, requirements for achieving their next badge, and rewards for receiving their next badge. Providing more clues and using a solid variable reward schedule were not possible due to the technical limitations of the LMS, but this this could greatly improve the study design.

The length of the course and research were limited to nine observations. This length might be sufficient; however, longer duration for different types of data analysis, such as time series analysis, might be needed (Jebb, Tay, Wang, & Huang, 2015). According to Jebb et al.

time series studies generally include at least 20 observations over time (2015), and a time series should be long enough to capture the phenomena of interest (Jebb et al., 2015). Nine observations may not have been enough to be able to identify a data trend.

Many students took this course due to department requirements. Students also were mainly from different fields of study and their motivation for taking this course might only be to complete their required courses. Total time spent in online learning is not only based on students' learning needs. It also depends on students' time availability for learning activities, which can be limited by professional, family, and social commitments. These points might cause students to focus on finishing the course with a good grade instead of learning deeper and further.

Finally, people who are familiar with gaming and game mechanics may not feel they are in a natural course environment if the course does not include game mechanics appropriately. People may feel that game mechanics try to manipulate their behavior and, as a result, disengage from the content.

5.7. Suggestions for Further Course Design and Research

Game-like hidden badges in an asynchronous online computer-skills course have a potential to improve students' behavioral engagement. However, the reward schedule may be variable and needs to be improved by considering the proximity to rewards including clues and reminders. Also, students' profiles—which help students to track their progress, establish sub-goals, and share their progress as they wish—may be implemented to engage students with the course content and their peers during the learning progress (Medler & Magerko, 2011). Reward schedules, clues, reminders, and profiles are essential for efficient implementation of game mechanics. An insufficient reward schedule would let learners focus on only scoring more points in effort to win the competition. On the other hand, if the design keeps rewarding players

regularly after their accomplishments, the environment might become predictable and boring once they understand the reward structure. As a result, it may not be fun for the participants. If a subject is made more fun to participate via the use of game mechanics, that subject may not be as intimidating nor seem as difficult to them.

I recommend using different types of badge or reward schedules. Students may be able to gain badges or rewards for different types of tasks and through multiple channels. If badges or rewards can be achieved via different tasks (e.g., uploading an assignment, making comments to the discussion board, etc.) and through different channels (e.g., Dropbox, email, etc.), this increases the chances of a student achieving a badge earlier in the course. With Dropbox as the only channel for reward or badge achievement, some participants might have a difficult time submitting their assignments and be unable to achieve a game-like hidden badge until later in the course; this exposure limitation might mean that motivation to progress is hindered.

Using different kinds of badges achievable via a variety of tasks provides a greater chance for participants to find the badge type they like the most. If they are not interested in achieving one type, they still have an opportunity to remain engaged in the course so they can attain other types of rewards. For instance, Goehle implemented levels and achievements into an online homework program (Goehle, 2013) incorporating three types of achievements: answering optional questions, succeeding in solving a homework problem, and reaching hidden achievements that were not visible to students until they were awarded. Based on the results of Goehle's study, game design was successful in helping students engage with overwhelming enthusiasm for the system (Goehle, 2013). Hew et al. (2016) used different types of reward schedules via their game-like design in the Designing Questionnaire course that 11 students attended. The students could choose one of six different topics from a list of readings on the

course content, which were categorized into easy, medium, and harder topics, for which one point, two and three points were awarded respectively. As a result of the study, game mechanics improved the students' participation in the discussion, and they chose more difficult tasks to complete due to more points being awarded for them. Students also stated that they enjoyed using the game mechanics design (Hew et al., 2016). Faghihi et al. (2014) designed MathDungeon, which allowed the students to select the concepts and exercises based on their preferences and offers. MathDungeon included hints and feedback for each course concept and offered different levels of difficulty. Each problem must be solved within a specific time frame. Students have the flexibility to select their course activity and a chance to practice and receive a hint with a picture and spoken message. As a result of the study, the math performance of students who used MathDungeon was higher than students who used a non-gamified system (Faghihi et al., 2014).

Following the week 6 assignment in this study, there are no statistically significant differences in time spent for the remainder of the course. This result might be evidence that the participant understood where the hidden badges were most likely to be integrated and focused on the elements where the badges come from. The uncertainty as to which tasks might be connected to achieving hidden badges is essential to keep students engaged with the course materials and with their peers. This could be made possible by improving the reward schedule. If the participants were unable to predict where the rewards were coming from or what they were going to receive as a reward, they could continue spending more time with the course material and peers. It is important to have a balance between the uncertainty and predictability of the reward schedules considering the role of the clues, reminders, and students' profiles which help

students to track their activities and improve students' behavioral engagement in asynchronous courses.

This study would be designed differently to examine the impact of game mechanics on students' behavioral engagement using variable reward schedules including different channels such as dropbox and discussion posts at the same time. Therefore, students are able to receive different types of rewards in different frequencies. I would also design the study next time creating a platform that lets students track their reward progress and provides students clues and reminders to receive their rewards without violating students' privacy and confidentiality to determine the value of game-like hidden badges. While designing all of the game mechanics, I would use a natural language instead of using exaggerated game language to keep the natural course environment for students who feel that game mechanics try to manipulate their behavior.

I would also design the future study using the widgets of the LMS (if it is possible within the university system) to make the study design more independent from the course instructors. For instance, setting up a widget to send students their badges via email immediately when students achieve a task to receive a badge. Therefore, students might able to experience the results of their actions immediately, lower the instructors' responsibilities, and minimize differences from an instructor to an instructor. However, I would not create fully automated game design since the widgets may not able to check the quality of students' work. For instance, if students qualify to receive a badge due to the number of discussion posts they write, it is important to provide them different types of badges related to their quality of work.

I would use open-ended questions in the survey and include specific questions about game-like hidden badges that they experience to understand their perception on the impacts of game-like hidden badges on their engagement in class to extend their response options. For

instance, some students may find game-like hidden badges very engaging. However, some are not able to spend a lot of time in class due to their other commitments, and some students are good at doing their assignments based on their prior experience and do not need to spend more time online. Open-ended questions may produce more in-depth responses, leading to increased understanding of students' behavioral engagement.

Grade in this study may not be a perfect tool to measure the differences and relationships between the variables. I would adjust the grading system to have a better understanding of the impacts of game mechanics on learning outcomes. Providing a rubric for students on each assignment would be helpful; based on the rubrics, instructors and students of the course might have a clearer understanding of the assignment requirements. Therefore, students might have a better chance to meet and exceed their course expectation, and instructors might provide individual feedback and grade based on each student assignment. Also, instructors of the course might see if the course expectation is easy or difficult for students in class. Using rubrics, students might receive a grade that more accurately reflects learning outcomes, instead of awarding an A in class as long as students submit their course work.

To measure total time spent accurately, I would design learning activities in the learning management system to lower the possibility of students printing out the materials and set frequent automatic logout times if a student does not engage in an online course. Time spent data could be useful in measuring student engagement in online asynchronous learning environments. Erlinda and Roinasol (2016) examined the reading comprehension ability of sixth grade students and found that time spent in reading was significantly related to interpretive and applied comprehension. In addition to in-person time spent data, online time spent data were researched and analyzed. Arif, Gazzaz, and Kahn (2013) studied social integration with time spent online

using senior level undergraduate students at a public university in Malaysia. They found that social integration had an inverse relationship with time spent online. In this study, however, time spent is the time the participants spent on the online course with their course material and peers. I used the time spent to measure the students' behavioral engagement. The accuracy of time spent data has been debated in online learning studies because students may leave the learning site open and do something else, such as check social media or play a computer game, or they may just print the material and close the course page. Martin and Whitmer (2016) emphasized that student learning behavior is highly variable, regardless of the course schedule. Some students prefer to move ahead, while others struggle to get their work done by the due dates. Martin and Whitmer (2016) found a significant difference between with-timed adaptive release and without-timed adaptive release groups on student interaction as measured by logins, total time spent, average time per session, content modules accessed, and time between module open and access in an asynchronously online course.

Finally, there might be a potential to identify a data trend in class on the impact of game-like hidden badges throughout semesters using a time series analysis if the course content is similar to each other every week. Other studies found patterning and predicting the students' behaviors (Cerezo, Sánchez-Santillán, Paule-Ruiz, & Núñez, 2016; Kim et al., 2016). As indicated in previous studies, time spent in different resources and actions regarding students' behavioral engagement is essential. The challenging issue related to time spent data is whether it can be determined that students are actually engaging or not with the course material and their peers in the learning course. However, time spent might not be a perfect tool to show overall statistically significant differences in both treatment and control groups in this study. Total time spent is a tool better used to show repeated measures.

5.8. Summary

The outcomes of game-like implementations could be different: positive motivation outcomes, positive learning outcomes, and negative or half negative outcomes. Various game elements could impact students' learning and engagement differently. This research might provide evidence of the impacts of the hidden badges on students' behavioral engagement in this specific asynchronous online setting. The results of this study might be used by instructors to provide recommendations aimed at successful online course design.

Berns, Gonzalez-Pardo, and Camacho (2013) created a virtual world to implement game-like applications and found that game mechanics have a potential to motivate learners for effective learning. They recommended that game mechanics should be used as a complementary platform to face-face-teaching, since the game mechanics cannot replace the use of LMS platforms. I agree with Berns et al. that game mechanics could complement face-to-face teaching and add that game mechanics could improve the LMS platform. However, LMS platforms may need to be improved before game mechanics can be implemented effectively to engage students with their course materials and peers. Finally, these results may provide objective data not only for game mechanics but also for future quasi-treatment research study utilizing both quantitative data to examine students' behavioral engagement in this specific asynchronous online setting.

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APPENDICES

Appendix A: Online Student Engagement Scale

The strikethrough items below were eliminated from the actual survey that was implemented in this study due to the relevancy to the research questions.

Online Student Engagement Scale (OSE)

Within that course, how well do the following behaviors describe you? Please answer using the following scale:

1. Not at all characteristic of me
2. Not really characteristic of me
3. Moderately characteristic of me
4. Characteristic of me
5. Very characteristic of me

1. Making sure to study on a regular basis
2. Putting forth effort
3. Doing all the homework
4. Staying up on the readings
5. Looking over class notes between getting online to make sure I understand the material
6. Being organized
~~7. Taking good notes over readings, PowerPoints, or video lectures~~
~~8. Listening/reading carefully~~
9. Entering the online class multiple times a week
~~10. Finding ways to make the course material relevant to my life~~
11. Applying course material to my life

12. Finding ways to make the course interesting to me

~~13. Thinking about the course between times I am online~~

~~14. Really desiring to learn the material~~

15. Visiting or calling the instructor with questions about the material and/or assignments

16. Emailing or posting questions when I don't understand the material and/or assignments

17. Having fun in online chats, discussions or via email with the instructor or other students

18. Participating actively in discussion forums

19. Helping fellow students

20. Getting a good grade

~~21. Doing well on the tests/quizzes~~

~~22. Being confident that I can learn and do well in the class~~

23. Taking advantage of all class resources (i.e., extra links, readings etc.)

24. Engaging in conversations online (chat, discussions, email)

~~25. Critically thinking about my own ethics, priorities, beliefs and values in the context of the class~~

26. Posting in the discussion forum regularly

27. Emailing the instructor regarding my grade in the class

28. Checking my grades online

29. Getting to know other students in the class

30. Assessing my own learning and progress in the class

Appendix B: Student Characteristics Data Collection

1. What is your current class year?

Freshman Sophomore Junior Senior Other

2. What is your age?
   Under 18
   18-20
   21-23
   23-25
   Over 25

3. What is your gender?
   Male Female

4. What is your current or intended major?

5. How long have you been using the Internet (including using e-mail, gopher, ftp, etc.)?
   a. Less than 6 months
   b. 6-12 months
   c. 1-3 years
   d. 4 to 6 years
   e. 7 years or more

6. How frequently do you access the web from the following locations?

	Daily	Weekly	Monthly	Less than once a month	Never
From home (including a home office)	○	○	○	○	○
From work	○	○	○	○	○
From school	○	○	○	○	○
From a public terminal	○	○	○	○	○
Other	○	○	○	○	○

Appendix C: The List of Hidden Badges

	W	Graphics	A Brief Email	Definition of tasks	Credit
Sep 4	1		Congratulations! You have earned the hidden badge by posting your blog link as the first post. I am so proud of you. Thank you for your hard efforts! Keep going up with it! Your badge is worth 0.2 points. Continue collecting!	Students post on the discussion board first.	0.2
August 28	2		Hi there [insert name]. You have earned a hidden badge. That's amazing, Congratulations!! I'm so proud of you for all the hard work you put into this course, you are doing such a fantastical job by providing advice on how to be a successful online student. I just wanted to drop in and say that all your hard work is not going unnoticed! Keep up the good work and being your awesome, amazing self! Your badge is worth 0.2 points. Continue collecting!	Students post to their blog three pieces of advice on how to be a successful online student.	0.2
Sept 11	3		Hello (name)! I just wanted to congratulate you on achieving your hidden badge! Feel free to email me anytime if you have any questions or want some support! You are a great researcher. Your badge is worth 0.2 points. Continue collecting!	Whoever did search online to suggest mobile applications, comes with new tools and exceed the assignment's expectation.	0.2
Sep 18	4		Hi there, (insert name here). I noticed you just received a new hidden badge, how awesome is that?! You should be very proud of yourself! You are very good at citing resources. Keep up the good work and don't hesitate to email me with any question! :) Your badge is worth 0.2 points. Continue collecting!	Students exceed the assignment's expectation.	0.2
Oct 2	5		Hey, (Insert name here)! I just wanted to say you've been doing excellent work in replying to your classmate's posts. Congratulations on becoming Peer	Students reply to others' posts.	0.2

			Support by the way, and I hope you realize how much you're appreciated here! Your badge is worth 0.2 points. Continue collecting!		
Oct 9	6		Hey, (insert name here)! Thank you for taking your time to share your ideas with others! What you are doing is so important to the classroom! Congratulations on earning the hidden badge. You are doing so well! Keep up the good work! If you ever need to talk you can always email me! Your badge is worth 0.2 points. Continue collecting!	Students reply to others' posts more than two.	0.2
Oct 16	7		Hope that you are having a great day and that you are feeling wonderful. Congratulations on achieving your hidden badge. I am so proud of what you are doing and keep up the great work. You have a great resume. Your badge is worth 0.2 points. Continue collecting!	Students exceed the expectations by creating a resume.	0.2
Oct 23	8		Hi there (insert name) today I saw you earned a hidden badge. I appreciate all your hard work you are doing here. You created an excellent spreadsheet. Please if you have any questions or just need to chat please send me a pm. Your badge is worth 0.2 points. Continue collecting!	Students exceed the expectations by creating the spreadsheet.	0.3
Oct 30	9		Hello (insert name), thank you for your dedication in class. Congratulations on achieving your hidden badge. I recognize and appreciate your hard work and growth. Your badge is worth 0.2 points.	Students exceeded the expectations evaluating the presentations.	0.3

Appendix D: Course Syllabus

Reading	Assignment	Topic	Date Due
Unit 1	Assignment 1.1	Essentials for a Successful Online Student	Aug 28
Unit 2	Assignment 2.1 Assignment 2.2	Online Communication & Collaboration	Sept 4
Unit 3	Assignment 3.1 Assignment 3.2	Creating a Personal Learning Env.	Sept 11
Unit 4	Assignment 4.1	Information Literacy 1	Sept 18
Unit 4	Assignment 4.2 Assignment 4.3	Information Literacy 2	Sept 25
Unit 5	Assignment 5.1	Cyber - Ethics and Security 1	Oct 2
Unit 5	Assignment 5.2	Cyber - Ethics and Security 2	Oct 9
Unit 6	Assignment 6.1 Assignment 6.2 Assignment 6.3	Creating Professional Documents	Oct 16
Unit 7	Assignment 7.1	Working with Data using Spreadsheets	Oct 23
Unit 8	Assignment 8.2 Assignment 8.3	Effective Presentations	Oct 30
Unit 9	Assignment 9.1	Web Design & Development 1	Nov 6
Unit 9	Assignment 9.2 Assignment 9.4	Web Design & Development 2	Nov 13
Unit 10	Assignment 10.1	Intro to Coding 1	Nov 20
Unit 10	Assignment 10.2	Intro to Coding 2	Dec 4
	Assignment 9.3	Final Project: Personal Webpage	Dec 11

Appendix E: Game-like Hidden Badge Instructor Guide

Georgia State University

Department of Learning Technologies

Instructor Guideline – LT 2010

Purpose: You are invited to be a part of a research study. The purpose of the study is to increase the quality of LT 2010 for all students of the course and to investigate how to engage students with the course materials and their peers in an online course. The purpose of this guideline is to help you design your LT 2010 section by implementing the game mechanics and explaining the game mechanics implemented in this course to your students.

Procedure:

1. Explain to your students the study and the game mechanics' procedure by using the text below in this course via the syllabus and welcome message on the announcement section.

   "You will be completing various weekly learning activities via discussion boards, blogs, and dropbox. Based on your completion of the learning activities, you will receive a game-like hidden badge by email. You will convert your badges to extra 2 credits at the end of the semester you may stop participating to the game at any time, there will also be extra 2 credits offered for writing a two-page reflection paper on how the skills learned in this course can help you with your studies if you decide not to participate to the game."
2. Set up the informed consent form on the announcement section. I will help the instructors to set it up before the course starts.
3. Each student receives 15 game-like hidden badges if they fully complete the assigned tasks for the game-like hidden badges during the semester. I designed hidden game-like badges for each week including a value of the badge, a graphic, and a brief email to send to a student.

You, as an instructor, will check whether a student is able to complete a task to receive a game-like hidden badge or not. If the student completes the task, you send a value of the badge and a graphic via a brief email including the brief email text on the badge list.

4. Every week, the instructors check the students' responses for the assigned task of the game-like badges and email their badges to the students who complete the assigned task. The game-like hidden badges will be awarded weekly. I recommend that instructors check the weekly tasks to receive game-like hidden tokes before grading the students' weekly assignments and take note a student or students' name if they need. At the end of the semester, the instructors check your emails as your record to convert game-like badges to extra credit. The instructors provide the students the extra credit if they do not write the reflection paper. The instructors use the gradebook to add extra grades to the students' overall grades.
5. All students who accomplish the assigned criteria will receive emails about their badges even though they did not consent to participate to the study in order to make sure that the instructors will not know who is or is not participating to the study. They will receive extra credit for their badges if they do not write a reflection paper. However, if they write a reflection paper they will not receive extra credit for their badges. Also, the students who receive the badges by accomplishing the assigned tasks and do not write a reflection paper, and did not consent will still receive extra credit for their badges. Only the data from the students who consent will be used at the end of the course.
6. Contact Persons: Contact Aysegul Gok at 770-905-0618 or email agok1@student.gsu.edu if you have questions, concerns, or complaints about this study design.

Appendix F: Consent Form

Georgia State University

Department of Learning Technologies

Informed Consent

Title: Examining Game-Like Design Elements and Student Engagement in an Online Asynchronous Course for Undergraduate University Students

Principal Investigator: Brendan Calandra

Co-Investigator: Aysegul Gok

I. Purpose:

You are invited to participate in a research study. The purpose of the study is to increase the quality of LT 2010 for all students of the course and to investigate how to engage students with the course materials and their peers in an online course. You are invited to participate because you are a student in LT 2010. A total of 250 participants will be recruited for this study. Participation will require around two hours of your time over the semester.

II. Procedures:

If you decide to participate, we will ask you some questions about your experience in the class at the end of the semester. We will also examine your online experience. This means looking at how many times you logged in, when you turned in assignments, and how often you communicated with others in class. When we look at this data, none of it will be traceable to you. No data we collect will be used to change your student experience in LT 2010 or your grade.

III. Risks:

In this study, you will not have any more risks than you would in a normal day of life.

IV. Benefits:

Participation in this study may or may not benefit you personally. Overall, we hope to gain information about how to improve the quality of online asynchronous undergraduate courses by increasing students' behavioral engagement with their course material and peers.

V. Compensation:

There will be 2 points of extra credit offered for participation. You will be completing various weekly learning activities via discussion boards, blogs, and optional assignments. Based on your completion of the learning activities, you will receive a game-like hidden badge by email if you participate in the study, but there will also be extra credit offered for writing a two-page reflection paper on how the skills learned in this course can help you with your studies.

VI. Voluntary Participation and Withdrawal:

Participation in research is voluntary. You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. Whatever you decide, you will not lose any benefits to which you are otherwise entitled.

VII. Confidentiality:

We will keep your records private to the extent allowed by law. Our research team (named above) will have access to the information you provide. Information may also be shared with those who make sure the study is done correctly—the GSU Institutional Review Board (IRB) and the Office for Human Research Protection (OHRP). Your name will be collected. The only purpose of collecting the names is to make sure that the data I am receiving is from those that consented to participate. The research data will be analyzed after the final grades will be submitted. Therefore no instructors will know who consents or does not consent till the end of

the semester. You will not be identified personally after the data collection. This means that the findings will be summarized and reported in group form. No part of the data can be traced back to you. Your name and other facts that might point to you will not appear when we present this study or publish its results. You should be aware that data sent over the Internet may not be secure. The data will be stored via password- and firewall-protected computers to which only the study team have access. The study team will be using a code sheet to identify the research participants. The code sheet will be stored separately from the data to protect privacy. Finally, we will not be collecting IP addresses.

VII. Contact Persons:

Contact Brendan Calandra at 404-413-8420 if you have questions, concerns, or complaints about this study. You can also call if you think you have been harmed by the study. Call Susan Vogtner in the Georgia State University Office of Research Integrity at 404-413-3513 or svogtner1@gsu.edu if you want to talk to someone who is not part of the study team. You can talk about questions, concerns, offer input, obtain information, or suggestions about the study. You can also call Susan Vogtner if you have questions or concerns about your rights in this study.

VIII. Copy of Consent Form to Subject:

You can print a copy of the consent form for your records.

If you agree to participate in this research, please check the box. □

Student Name

Appendix G: Recritment Message

Recruitment message

You are invited to participate in a research study. The purpose of the study is to increase the quality of LT 2010 for all students of the course and to investigate how students engage with the course materials and their peers in an online course.

You are invited to participate because you are a student in LT 2010. A total of 250 participants will be recruited for this study. Participation will require around 30 minutes of your time over the semester.

If you decide to participate, we will ask you some questions about your experience in the class at the end of the semester. We will also examine your online experience. This means looking at how many times you logged in and how often you communicated with others in class. No data we collect will be used to change your student experience in LT 2010 or your grade. When we analyze this data, none of it will be traceable to you.

There will be 2 points of extra credit offered for participation, but there will also be extra credit offered for writing a two-page reflection paper on how the skills learned in this course can help you with your college studies.