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Integrating Gamification Principles into Photography Skill Learning: The Influence of Games on Student Motivation

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Abstract

Changes to the global economic environment have introduced innovations in technology that replace human workers to complete repetitive tasks. Due to the removal of these jobs, workers are required to develop new skills to compete for emerging jobs. However, lack of motivation to learn skills and content taught in schools has been a problem that creates the possibility that current students will not be prepared to enter the future workforce. To help improve intrinsic motivation and skills development, gamification has been explored as a mechanism for learning. The aim of this study was to explore the six intrinsically motivating factors required for gamified design (Malone & Lepper, 1987) and their effect on learning outcomes. One hundred thirty-one middle school students participated in the game CLICK that was designed to teach them photography skills. At the conclusion of the game, students were tested on their photography knowledge and given the Intrinsic Motivations Survey to record feelings about their game experience. Multiple regression analysis was conducted on test and survey data for all students, female students only, and male students only. Findings from these analyses show that curiosity and control predicted test scores for all students and male students. There were no predictor variables that predicted test scores for female students, but the number of participants for female and male groups was too small and should not be used to inform gamified design for gender-specific applications. A maximum likelihood estimation SEM model was generated using test and survey data from all students and had an excellent fit to the data (Model $\chi^2 = 9.35$, $p = .499$; RMSEA < .001; CFI = 1.000; TLI = 1.002). This model showed that curiosity, control, and challenge had direct and indirect effects on test scores. Findings from this study show that: (a) curiosity is a necessary factor that needs to be embedded into gamified design; (b) control needs to be managed to avoid poor learning outcomes; and (c) challenges need to be implemented to promote curiosity and avoid control issues.

Keywords: gamification, intrinsic motivation, middle school students

Dedication

This dissertation is dedicated to my wife, Mary, who made my journey through the doctoral program possible. Her patience and support through these years has helped me to get done with all of the required coursework, activities, and long hours working on papers and assignments for my classes. She provided countless hours of support listening to me talk about gamification and learning, proofreading my papers, keeping me sane and focused, and encouraging me to keep moving forward. Thank you will never be enough for everything you have done. I love you most!

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Chapter 1 – Introduction

Statement of the Problem

Due to the changing nature of the global economic environment, the educational landscape has been going through its own transformation so that future workers are better equipped to be successful in new and emerging careers. The transformation is attributed to changes in job skills that involve higher-order thinking skills, which requires educators to prepare students to be competitive in a global work environment (Boyles, 2012). The shift in requirements for workers has caused the educational landscape to change from a model where information is absorbed through teacher-centered interactions to one where learners are expected to demonstrate competencies in skills needed in the workplace. Some of the skills expected to be developed include creative thinking, problem solving, collaboration, and communication (Wagner, 2014; Partnership for 21st Century Skills, 2015). These skills have become necessary for future workers to develop as computers have the capacity to perform repetitive tasks accurately, replacing human workers in the process (Borenstein, 2011).

Despite the need for learners to develop 21st century skills to be job-ready, teachers are having difficulties motivating students to learn and develop these skills. This may be related to the use of longstanding teacher-centered methods, such as large-group lecture, where students are passive learners and may not understand or find value in what is being taught (Kapp, 2012a). Despite the number of students present at a lecture, little or no interaction takes place between students to discuss or inquire about the content they are learning (Banfield & Wilkerson, 2014). Repeated use of this method of teaching creates an environment where students are passively engaged and missing out on key skill development opportunities that can prepare them in the changing workplace (Berkling & Thomas, 2013). It can also lead to an increase in other problem behaviors such as cheating, learned helplessness, and dropping out (Lee & Hammer, 2011). The

extended duration that students are passively engaged leads to an overreliance on extrinsic motivators, such as grades, credits, and diplomas, and creates learners who are disinterested in learning (Mozelius, 2014).

Another problem affecting engagement and motivation is the reliance on test data to show student growth and progress. Test-oriented learning environments can cause teachers to deliver content with teacher-centered methods, which create students who are not always expected to be willing participants in their learning (Kapp, 2012a). Test-oriented learning environments have also caused some schools to try unsuccessful motivation tactics, such as paying students for earning high grades and test scores (Morris, 2008). The lack of motivation caused by schools that focus on test scores as measures of achievement and teaching methods that do not fit learner needs can affect student preparation for careers in a globalized society (Uscinski, 2013).

In summary, the problem with current education methods is that students may not be motivated to learn because they feel that they are not being taught in ways that actively engage them in learning. The lack of motivation to learn can cause students to become disinterested in acquiring new knowledge and skills necessary to be effective members of a global work force.

Gamification

In an effort to improve engagement and help students to develop 21st century skills, educators and researchers have started to look at gamification as a means to improve intrinsic motivation toward learning while reducing the reliance on extrinsic motivators. Gamification is defined as “the use of game design elements in non-game contexts” (Deterding, Dixon, Khaled, & Nacke, 2011, p. 10). Classrooms are spaces where games are not common or expected to be seen, which makes it an environment where gamification can be applied. Applying gamification

to classroom experiences allows educators to apply some game design elements to lessons and units without having to apply fully-formed games, such as those used in game-based learning. This section provides a brief overview of how gamification and motivation are linked and how integrating gamification in classroom experiences can improve student motivation.

Gamification as Motivation

Gamification has been used to help individuals improve intrinsic motivation in real-world tasks that might not usually be enjoyable. Game design elements have been used to enhance non-game situations such as design and digital marketing (Deterding et al., 2011) and many areas of daily life, including fitness, driving, wellness activities, improving productivity, finances, and education (Barata, Gama, Jorge, & Goncalves, 2015; Kim, 2015a; Kim & Lee, 2013; Morford, Witts, Killingsworth, & Alavosius, 2014). When a gamified design is applied to these tasks, it is possible that participants will find tasks more enjoyable and be motivated to complete them (Zuckerman & Gal-Oz, 2014). Gamification takes advantage of the popularity of games to positively impact people's lives by changing their view of a tedious activity to one that is more interesting (Morford et al., 2014).

Components of a gamified design, including rules, objectives, and reward structures, create opportunities for participants to adapt behavior and use competition as motivation. The opportunities presented for individuals to improve themselves or compare their skills against others can draw interest toward taking part in a gamified system. For example, the use of badges, points, and leaderboards can increase interest and fun and make tasks more appealing because participants view their progress against others (Lamprinou & Paraskeva, 2015; Measles & Abu-Dawood, 2015). Participants become engaged and motivated to play because they are taking part in the activity with family, friends, and other players from around the world. Using gamification

changes tasks from being a solitary activity to a social activity and can motivate participants to improve their skills and abilities based on how they see others progressing.

Gamification in Education

Based on the success found in business applications of gamification, school personnel have been looking at gamification as a method of engaging students in learning. Games are an integral part of human culture and influence our social and leisure lives (Seaborn & Fels, 2015), and have the ability to garner attention and promote engagement when there is social interaction and knowledge sharing (Kim, 2015b; Simoes, Redondo, & Vilas, 2013). Using games as a method of learning can change how students view learning tasks because they have the opportunity to immerse themselves in the gamified learning experience, which may not happen in traditional learning settings (Lee & Hammer, 2011; Vos, van der Meijden, & Denessen, 2011). Based on the nature of games and how they promote interaction and learning, it is possible that gamifying learning experiences can motivate students to learn since they are interacting with others and actively engaged in learning new material.

Using games as teaching tools provides instructors with the ability to develop specialized content that actively engages students in the learning process (Su & Cheng, 2014). By applying game design elements to a learning environment, teachers can help students to find internal value in learning instead of looking for external motivators to drive them, such as grades, diplomas, or negative reinforcement for failing to complete class assignments. Gamifying learning experiences can help students who are disengaged with traditional learning approaches to find value in their learning (Cheong, Filippou, & Cheong, 2014). Gamification also allows educators to create learning environments where students are engaged in real-world learning, but learning is more fun because it appears more like a game than work.

Games have the ability to engage learners because they provide opportunities for trial-and-error that are often not found in traditional education. In fact, games invite learners to fail because learning occurs through trial-and-error until a working solution to a problem emerges (Kapp, 2012a; Dicheva, Dichev, Agre, & Angelova, 2015; McGonigal, 2011). Games also provide students with the opportunity to view a problem from different perspectives and use critical thinking to develop unique solutions, which can be a beneficial skill in the changing workforce (Gee, 2008; McGonigal, 2011). At early ages, using a gamified curriculum creates an environment where students can develop social skills, which can translate into 21st century skills that may be applied to future careers (Morford et al., 2014). Gamifying the learning experience presents educators with the opportunity to make learning fun and interesting while students develop knowledge and skills in an engaging environment.

Intrinsic Motivation Factors in Gamified Design

To gamify the learning experience and improve intrinsic motivation, educators take the components of games that make them fun and engaging and apply them to lessons and units (Deterding et al., 2011). The components of games used in gamified environments can be drawn from any game, including digital games, board games, playground games, and sports (Glover, 2013). Along with the rules and design elements taken from existing games, Malone and Lepper (1987) identified seven individual and interpersonal motivating factors that are necessary to design intrinsically motivating activities and created the Taxonomy of Intrinsic Motivations for Learning. These seven motivational factors were also discussed by Kapp (2012b) as necessary to create a gamified learning environment. The seven factors include: (a) challenge, (b) curiosity, (c) control, (d) fantasy, (e) cooperation, (f) competition, and (g) recognition.

For this study, all of these factors except fantasy were explored. Fantasy was excluded because the game used in this study did not necessarily cause students to feel that they were taking the role of a professional photographer. Applications of fantasy in games could include acting as a historian in a gamified social studies curriculum or as a scientist in gamified science lessons.

Photography Skills and Motivation

In an effort to improve intrinsic motivation to complete learning tasks, photography was used as the focus for the gamified unit. Photography is considered a naturally motivating activity because each person takes pictures of items that interest them (Horner, 2016). Photographers find motivation to take high-quality photographs because of the camera they are using, the subject they want to photograph, or the memory they want to preserve.

Students can achieve higher levels of intrinsic motivation in learning tasks when photography is integrated into lesson design. For example, Lilly and Fields (2014) conducted a study where students used photographs as part of an informational writing project. The researchers found that students were more engaged and intrinsically motivated to improve their writing skills because they could use personal photographs to help develop ideas and fill in gaps in their writing. With the integration of photographs, students were able to experiment with different writing styles and provide more details, which improved their overall writing skills.

Motivating students to learn new photography skills can be done using a gamified learning environment (Horner, 2016). Since gamification and photography both rely on participants to be intrinsically motivated, students can be motivated to learn new photography skills using a gamified lesson design. To generate intrinsic interest in learning, Horner (2016) provided two suggestions for designing a gamified experience. First, the designer needs to

consider using or repurposing a rule set from an existing game. This allows students to begin playing the game quickly and maintain interest in playing, which could be reduced if they have to learn a new, complex rule set. Second, students can develop intrinsic motivation to learn if the teacher is a game manager and observer. If the teacher acts as a referee and minimally interferes with game play, students will need to rely on their skills to complete game objectives instead of a singular outcome that the teacher would expect. A gamified experience used to teach photography skills with minimal teacher interference can create opportunities for students to find motivation to learn new photography skills through cooperation, competition, and experimentation, which can lead to improvement in photography skills.

Gender and Gamification

There are many studies that explore gamification and learning, but very few have explored how gamification affects students based on gender. Koivisto and Hamari (2014) found in a non-educational gamified experience that women are more motivated by recognition than men, but there were no differences in other aspects of the experience based on gender. Another study by Pedro, Lopes, Prates, Vassileva, and Isotani (2015) found that males in a gamified learning environment were more engaged and motivated to learn than males in a non-gamified environment. However, the authors did not note what factors of the gamified experience, especially those factors detailed by Malone and Lepper (1987), engaged and motivated them. The lack of information that can be used to tailor gamified experiences to students of each gender creates a need for studies to be done to determine which motivational factors engage students in the learning process.

Purpose and Study Questions

The purpose of this study was to determine which motivational factors are most important when developing gamified learning experiences. When developing a gamified curriculum for a diverse classroom, it is important to include those intrinsically motivating factors that are going to engage the entire class. Since some learning experiences can be gender-exclusive, it is also important to know which specific motivating factors are going to work best when developing lesson design. Specifically, the following research questions were explored:

1. In a gamified learning experience, which combination of intrinsically motivating factors (challenge, curiosity, control, cooperation, competition, and recognition) best predicts a participant's score on a photography skills assessment?
2. Which combination of intrinsically motivating factors best predicts photography test scores for female students?
3. Which combination of intrinsically motivating factors best predicts photography test scores for male students?
4. Which motivational variables have a direct or indirect effect on participant's scores on a photography skills assessment?

Rationale and Importance of this Study

The importance of this study can be described from three facets. First, it helped determine what aspects of gamified lessons motivate students to learn so that they can be explored and applied to other content areas. One of the problems this study addressed was how students interact with gamified systems since the effects of gamification can differ between individuals (Zuckerman & Gal-Oz, 2014). Determining which common motivational factors engage students

in learning in a gamified experience can guide other teachers to develop gamified instruction for their classrooms.

Second, this study explored gender perspectives and motivations to learn in a gamified curriculum (Koivisto & Hamari, 2014). Exploring which intrinsically motivating factors are most important to each gender can create a template for teachers to use to develop gamified instruction. Teachers can apply these findings to refine their curriculum so that the needs of all students can be met and improve learning motivation and content engagement.

Finally, this study addressed learning at the secondary education level. While there have been a variety of studies done in higher education (Caponetto, Earp, & Ott, 2014; de Sousa Borges, Durelli, Reis, & Isotani, 2014; Dicheva et al., 2015), few have been done that determine learner motivation at the secondary education level. The results of this study are expected to provide guidance for developing gamified curriculum for secondary level as well as other levels of education.

Photography Unit Rationale

In this study, photography was selected as the content of gamified learning to explore which of the six motivational factors are most useful to students when developing a gamified curriculum. In the classroom where this study took place, students learned photography skills as one of several technological skills they used to complete class projects. After students learned how to use presentation software such as PowerPoint, Prezi, and ActivInspire, they were taught how to take photos to enhance their presentations. The photography skills learned during this class were applied to videography skills so that students could take and use videos in presentations and projects.

Using the recommendations Horner (2016) provided to motivate students to learn photography through gamification, a gamified experience was created using elements from the basketball game HORSE. In the game HORSE, players attempt to make a shot successfully done by another player or be penalized for missing. Using the structure of this game to direct rules and gameplay, the game CLICK was created for students to develop photography and videography skills. More information about this game is provided in the Method chapter.

Although the class structure does not follow a strict set of learning standards, students developed photography skills that could be used in high school classes. For example, the Nevada Department of Education (2013) standards for Career and Technical Education include photography standards. The content learned in this unit aligned with Content Standard 5.0, in which students learn the photographic elements of design and composition. The basic skills learned in this gamified unit could help students to advance to more difficult photography skills earlier in their coursework so that they can move toward a career that uses these skills.

Limitations

There were several limitations that impacted the generalizability of this study. First, the researcher also developed the gamified unit and was the teacher for the classes used in this study. This may have had an effect on student responses on the Intrinsic Motivations Survey and caused students to not provide their real opinion of the gamified experience.

Another limitation was that the study was conducted over two semesters. This was necessary to acquire the number of participants necessary to conduct a multiple regression analysis and develop a structural equation model (SEM) from the six predictor variables. Every effort was made to make the experience the exact same between the two semesters, but there

may have been differences in how the game was administered that could have benefitted one semester group over another.

A third limitation to this study was that there were not enough participants to complete the analyses for male and female students. The information that could be gained from findings for each gender could be used to inform decisions on how to develop a gamified unit that benefits learners in gender-specific groups.

A fourth limitation for this study was that the game was implemented for an elective class that does not follow a strict set of standards and guidelines. This may have an impact on the generalizability of the study because other classes may have content requirements and time constraints that prohibit the use of gamified designs similar to the one used in this study.

A final limitation was that the responses provided by students did not take into account differences based on race or ethnicity. Since this study did not explore differences in motivation for race and ethnicity demographics, the findings were not able to predict differences in motivations to learn in gamified settings between those groups.

Summary

Due to the change in skills needed by future workers so that they can compete for jobs, educators are exploring and developing new ways to teach so that students actively participate in their learning. The purpose behind changing how educators teach is so that students are intrinsically motivated to learn and find value in their learning. However, not all students are intrinsically motivated to learn, which creates a challenge for educators to find methods of engaging them. One method educators are exploring to engage all students and improve intrinsic motivation to learn is through the use of gamification.

For this study, a gamified photography unit was used to explore which intrinsic motivators are correlated with learning new content. Using Malone and Lepper's Taxonomy of Intrinsic Motivators for Learning (1987) as guidance, a photography unit was developed to teach new content and determine what intrinsic motivators were most related to learning. This study also explored differences in intrinsic motivators based on gender due to the possibility that males and females are internally motivated to learn differently. Significant findings in this study can help to create guidance for teachers and instructional designers to create gamified curriculum that help students develop an intrinsic motivation to learn and develop career skills while playing games.

Chapter 2 - Literature Review

Introduction

In an effort to improve education and engage more students in learning, gamification has been explored as a mechanism for students to have a unique learning experience. The aim of gamified design is to make tasks that require a combination of intrinsic and extrinsic motivation to complete and to use game elements to entice individuals to make thoughtful choices (Morford et al., 2014). Due to the universal nature of games and their natural motivating power, integrating gamification principles into learning experiences seems like an ideal fit that should improve motivation to learn (Dicheva et al., 2015). This chapter begins with a review of intrinsic and extrinsic motivation and how they appear in classroom settings. Next, gamification is defined and differentiated from other learning environments that use games. This is followed by an analysis of the Taxonomy of Intrinsic Motivations for Learning developed by Malone and Lepper (1987) and suggested by Kapp (2012b) as a base for developing gamified curriculum. The literature review continues with an exploration of the benefits and problems associated with using a gamified curriculum in education and research study findings that show the efficacy of gamification. Finally, this chapter concludes with the purpose of this study and the questions that this study aims to resolve.

Motivation and Education

In every aspect of human life, there are internal and external factors that motivate an individual to do something. People can be motivated into action due to personal interest in a topic or through incentives earned when a task is completed, such as money or grades (Ryan & Deci, 2000). However, there are significant differences between intrinsic and extrinsic motivations and how and why they are used. This section includes an exploration of the

differences between intrinsic and extrinsic motivation and how schools have attempted to use them to motivate learning.

Intrinsic and Extrinsic Motivation

Intrinsic motivation and extrinsic motivation are related to internal and external factors that motivate a person to act. When a person has intrinsic motivation, they are participating in an activity or completing a task because they gain satisfaction from the task (Banfield & Wilkerson, 2014). For example, an individual may gain satisfaction from reading simply because they enjoy the act of reading. Intrinsic motivation helps an individual to seek out stronger challenges and to develop more knowledge and skills through their own motivation (Ryan & Deci, 2000). However, intrinsic motivation is very fragile and needs support and nurturing to survive. For example, a person who does not practice or enjoy the act of reading may resent it and choose not to read when given the option. For an individual to gain joy from a task, the joy must come from within and be reinforced.

Extrinsic motivation is in direct contrast with intrinsic motivation because the individual is motivated by some outside influence. When a person is extrinsically motivated, they are performing the task for some reward beyond the task (Ryan & Deci, 2000). For example, an individual may not enjoy the duties that he performs at his job, but he will still complete them so that he can earn money to do other tasks that he enjoys.

Problems with Extrinsic Motivation

In the educational realm, educators hope that students are intrinsically motivated to learn and find internal value and interest in what they are learning. However, an overreliance on extrinsic motivators, such as food, grades, and tangible reinforcements, may have a negative effect on intrinsic motivation and cause students to find less value in learning new material

(Ryan & Deci, 2000). Intrinsically motivated students have a variety of advantages over externally motivated peers because they find the tasks enjoyable and are more likely to pursue academic tasks on their own without force (Lei, 2010). These students want to be educated because they find value in learning and collaborating with like-minded peers (Ryan & Deci, 2010). Conversely, students with higher external motivation than internal motivation may show less interest in learning tasks, blame their teachers for poor performance, and refuse to complete learning tasks if there is no incentive to do so (Lei, 2010; Ryan & Deci, 2000).

Extrinsically motivated students are at risk in the classroom because they may tend to have lower grades and have poor relationships with classmates and peers (Vecchione, Alessandri, & Marsicano, 2014). Even if an extrinsically motivated student is capable of completing a learning task, they may refuse to do so unless there is some incentive to complete the task (Lei, 2010). In short, extrinsically motivated students may miss out on many learning opportunities simply because they choose not to take part in them and need to be incentivized to do so.

Potential to Improve Motivation with Gamification

To help students become more intrinsically motivated to learn new material, instructors are tasked with helping students to find internal value in their learning while minimizing external incentives (Lei, 2010). One method of developing intrinsically motivated students is to develop gamified instruction where students learn new material while playing games.

Gamification has the potential to increase engagement in learning due to the natural human interest in playing games, which can lead to increased motivation to acquire and improve skills (Apostol, Zaharescu, & Alexe, 2013; Barata et al., 2015; Bíró, 2013; Measles & Abu-Dawood, 2015). The use of games creates moments where learners reflect on prior performance

and adjust their play style so that they can improve their standing compared to other players. To remain competitive in a game, students must stretch their limits and develop more knowledge and skills so that they are better equipped to succeed compared to their peers (Apostol et al., 2013). Gamified learning also has the potential for students to create a social environment where they learn more about their peers and develop a shared knowledge bank (Barata et al., 2015).

Gamification has the potential to create motivation and engagement in students, especially in those who are generally extrinsically motivated, because players receive unexpected rewards for "winning" the game as opposed to earning rewards simply by being in the classroom (Deci, Ryan, & Koester, 1999). Gamified learning systems rely on both intrinsic and extrinsic motivation (Lamprinou & Paraskeva, 2015), but the hope is that integrating game elements make students more intrinsically motivated because they have autonomy in their learning and can make choices as to how they learn new information (Ryan & Deci, 2000). Using gamification, educators have the opportunity to help students find value in their learning and seek out more knowledge on their own. By doing so, it is possible for students to become more intrinsically motivated to learn and rely less on external factors to drive them.

Gamification

The term gamification is relatively new, but the concepts behind gamification have existed throughout history. For example, badges earned through promotions in the military can be traced back to ancient Rome, while merit badges in the Boy Scouts of America have been used to show distinction among troop members (Antin & Churchill, 2011; Dicheva et al., 2015). The term gamification was introduced in a conference in the early 2000's and slowly grew in popularity as a way to promote businesses and their products (Groh, 2012). Using a gamified design, games were developed that could motivate and influence behavior and help promote

lifestyle changes for individuals who needed a motivational tool (Lee & Hammer, 2011). Games have been developed to encourage healthy lifestyle choices, including monitoring household energy use, exercise, and completion of everyday tasks.

Due to the success found from gamified business applications and the motivational power of games, gamification was introduced to the educational realm for research and application. Gamification is defined as "the use of game design elements in non-game contexts" (Deterding, et al., 2011, p. 10). This definition makes gamification different from other forms of game-based learning because it does not require teachers to use all of the design principles used to make full-fledged games. A teacher designing a gamified curriculum can select what components best fit her lesson design and leave out those that do not. Using this definition as the basis for gamified design, it is possible to create learning experiences for classroom use where the goal is learning new content in a fun and engaging way. Students who choose not to learn when traditional teaching methods are used may become engaged in learning content both consciously and subconsciously when games are the conduit for learning (Kapp, 2012a).

Serious Games, Simulations, and Game-Based Learning

Before any discussion on gamification can be done, it is important to differentiate gamification from other forms of game-assisted learning in the classroom. Three other forms of teaching and learning that use games include serious games, simulations, and game-based learning (GBL).

Serious games are a complete game experience that the player is immersed in while learning new content (Cheong et al., 2014). Serious games allow participants to test solutions to a problem in a controlled environment and are a beneficial tool when solutions cannot be tested in the real world due to cost, time, and safety constraints. For example, IBM developed a serious

game called *CityOne* that allowed city planners to design changes to a city in preparation for population growth and potential problems with development (Clancy, 2010). In educational settings, all students are expected to play the same serious game at the same time to learn and explore content together (Simoes et al., 2013). Using serious games requires that enough resources are available to accommodate all students participating at once.

Simulations are software applications that are used to predict what may happen in a defined scenario (Gee, 2008; Morris, Croker, Zimmerman, Gill, & Romig, 2013). Simulations allow users to test for outcomes that might not be observable, such as changing the mass of a planet or running a test hundreds of times to get consistent, accurate results. The Physics Education Technology (PhET) website (phet.colorado.edu) includes examples of simulations for math and science education. These simulations provide controlled environments where participants observe science and math principles and manipulate variables to view changes in outcomes. Viewing these simulations can allow for a deeper understanding of the concept in each scenario.

Game-based learning (GBL) uses full-fledged games paired with content to enhance learning and create experiences that players remember (Fan & Xiao, 2015; Isaacs, 2015). Some of the games used in GBL are serious games, but commercial off-the-shelf games like *Civilization* (Squire & Jenkins, 2008) or *Portal 2* (Pittman, 2013) are also used. Students learn while interacting with challenges delivered by the game and compete against each other to provide the best solution for each challenge.

Features of Gamification

Gamification is different from other forms of game-assisted learning because it does not use a complete game. Instead, gamified instructional design uses components of game design to

create a learning experience (Faiella & Ricciardi, 2015). These game elements can include the use of progress bars or points that move students toward a goal or objective. However, gamified systems use game elements for non-game-related purposes to give the look and feel of a game without being a full-fledged game (Olsson, Mozelius, & Collin, 2015). A gamified system has the power to motivate students to learn because it includes components that make games appealing to players and entices them to want to continue playing (Domínguez et al., 2013).

Another distinguishing feature of gamification is that it does not necessarily require electronic technology. While computer-based technology has improved each year and gamified apps have become more accessible, gamified experiences can be developed with as little or as much technology as the developer desires (Kim, 2015a). This facet is very beneficial for schools that have little or no technology at their disposal because games can still be created and played with students to give them a unique learning experience.

A third feature of gamification that makes it appealing in education is that gamification provides opportunities for the learner to fail without punishment. In games, failure is an expected outcome based on player decisions. When a player fails, it gives them the opportunity to discover why they failed so that they can change their strategy and possibly succeed on the next attempt (Kapp, 2012b; Lee & Hammer, 2011). Thinking through their mistakes allows students to learn that failure is a chance to improve instead of as a negative consequence (Morris et al., 2013). Shifting how failure is viewed changes how students approach failure and teaches them resilience when faced with challenges in other aspects of their life (Su & Cheng, 2014). Viewing failure as a positive consequence teaches students that failure is acceptable as long as efforts are made to change failure into success.

Examples of Gamified Environments

Educational environments that use game elements to engage learners already exist online. For example, Codecademy (www.codecademy.com) is an online gamified experience that teaches users how to code many different scripting languages. The application uses instant feedback, opportunities to fail, and on-the-spot guidance to help learners develop and hone skills in a coding language. Khan Academy (www.khanacademy.org) also provides a gamified experience for users to learn math, science, computing, and arts and humanities. These sites engage learners because they provide social engagement, visual status, freedom to choose what the user wants to learn, freedom to fail and retry, and rapid feedback (Dicheva et al., 2015). The success found by users of these websites would suggest that integrating these game elements would help to create a strong gamified experience for students.

Developing a Gamified Curriculum to Motivate Learners

Due to the nature of games and the way they invite individuals to interact with them, games can naturally intrinsically motivate users to keep playing (Measles & Abu-Dawood, 2015). Games also usually provide an extrinsic reward, such as tokens or ranking, to tempt participants to keep playing and improving their status compared to other players. When designing a gamified experience, it is important to carefully select game elements that have a balance of external and internal motivators so that interest is held for the duration of the experience (Lamprinou & Paraskeva, 2015). These game elements should also be age-appropriate and mesh well with the content they are learning (Glover, 2013). Gamified curriculum developers also cannot assume that gamifying learning experiences will automatically engage all learners (de-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014). Doing so may cause learners to have a negative experience and disengage from the game and the

intended learning outcomes. There are many things that need to be considered in order to develop an engaging, meaningful gamified experience for classroom use.

Along with rules, structure, and other factors that make the game enjoyable (Cronk, 2012; Kim, 2015c; McGonigal, 2011), Kapp (2012b) explained several internal and interpersonal motivating factors that makes games enjoyable to players. These motivational factors were taken from the Taxonomy of Intrinsic Motivations for Learning developed by Malone and Lepper (1987). This taxonomy included seven intrinsic motivations that need to be considered when developing gamified instruction to make it fun and engaging. Internal factors include: challenge based on goals, feedback, and uncertain outcomes; curiosity and inquiry; and control over choice and power. Interpersonal factors include cooperation between team members, competition between teams or individuals, and recognition of hard work that is visible to others. Using these factors as guidance for designing curriculum, the focus of the game moves toward the user experience and how these factors influence learning and interaction with the gamified content (Koivisto & Hamari, 2014). The omission of these intrinsic motivators may create disinterest in the game and have an adverse effect on learning. Good game design, then, requires that designers take these factors into account and apply them to the gamified experience.

Challenge

Challenge in a gamified experience requires player to be tested and adapt to new situations as their skills develop. When participants play a game, challenges help them to improve skills, try different methods to complete a task, and overcome difficulties through trial-and-error (Gumulak & Webber, 2011). When developing challenges in a gamified curriculum, the designer needs to consider goals, uncertain outcomes, feedback, and self-esteem.

Goals are important to gameplay because they tell the player what they are trying to achieve and what course of action they need to take to complete them. Goals create motivation because they provide players guidance and require them to develop skills past what they are currently capable of (Antin & Churchill, 2011). Goals should be provided from the start of the game and be updated as they are completed so that players have a new task to complete that challenges their skill level (Kapp, 2012b). Goals need to be carefully developed so that they are not too obvious or simple and require players to improve their skills gradually (Mozelius, 2014). They also need to be specific enough that players do not get confused by wording or multiple interpretations (Saunderson, 2011).

Along with developing goals that test player skills, Mozelius (2014) noted that outcomes for completing a goal should be uncertain. Malone and Lepper (1987) explained that uncertain outcomes exist because the player does not know if they can or cannot complete a goal and will need to attempt a solution to find out. Uncertainty of whether the goal is achievable and what rewards are attached to successfully completing them creates fun and engagement in the game (Wang & Sun, 2011).

Feedback is a critical piece to the gamified experience because it provides players with information about progress toward an objective or if goals have been completed (Saunderson, 2011). Feedback is critical for learning since specific feedback on student performance allows for reflection on past performance and improvements for future gameplay (Kapp, 2012a; Morris et al., 2013). This feedback can be spoken or written and can be used to praise success, provide hints on failure, or show scores and completion percentages that show overall performance (Measles & Abu-Dawood, 2015). In general, feedback needs to be provided as quickly as possible in a gamified curriculum so that the game keeps moving and players have the

opportunity to use new information in the next game segment (Gumulak & Webber, 2011). Feedback may help motivate students to perform better as they play the game and provide support to participants with lower skill levels so that they know what is expected of them when completing a challenge (Attali & Arieli-Attali, 2015; Charles, Charles, McNeill, Bustard, & Black, 2010).

The final component, self-esteem, is affected by the other components that make up a challenge. In a classroom, the self-esteem of an individual is affected by their success and failure and can have an impact on future performance (Malone & Lepper, 1987). A gamified curriculum takes the focus off of the absolutes of success and failure, such as those found on a test or a written assignment, and instead judges the player based on their competence and creativity when completing a challenge. When a player is judged and recognized for what they can do, they may experience a rise in self-esteem and attempt to improve their skills in future challenges.

Curiosity

Curiosity is an intrinsic motivator that drives learners to explore a topic more thoroughly. Since curiosity can naturally drive individuals to explore new concepts, Malone and Lepper (1987) believed that it is "the most direct intrinsic motivation for learning" (pg.235). While participating in a gamified experience, learners can seek out opportunities to expand their knowledge on new material because they are interested in it.

Gamified experiences create opportunities for players to learn more because curiosity helps them to create links between information they know and do not know (Morris et al., 2013). When new information emerges in an inquiry-based model, players will create links to existing knowledge by finding relevant information until they understand what they need to know (Gumulak & Webber, 2011). This understanding leads to more curiosity in complex topics

because each new discovery can lead to the potential of finding more information on the topic. Using curiosity, games with multiple goals and challenges can scaffold learning and help players discover new information as it becomes necessary and relevant.

Control

Control in a game environment is related to the amount of freedom that a participant has to work through goals and objectives. The control elements of a game need to have clear rules that define what a player can and cannot do while playing. To prepare for this, a rule set must be developed to referee gameplay and create restrictions on player actions when completing tasks (Morford et al., 2014). However, rules cannot be too restricting because it would mean that players must follow a singular path to success, which removes opportunities for risk-taking and variability in play. Players need to have the freedom to choose a path to success and have control over the strategy they use to complete an objective (Lee & Hammer, 2011). With the freedom to explore their skills and test what is acceptable within a rule set, players can be motivated to learn and show interest in the game because they feel they are in control of their learning (Vos et al., 2011).

Fantasy

The fantasy aspect of games is one where players feel they are part of an environment that is not actually present (Malone & Lepper, 1987). When a person plays a video game or reads a book, they may feel connected to the characters and world that is not actually there. This feeling of fantasy may not always be embedded in games, but is a strong motivator and makes the player feel compelled to maintain interest and engagement in the game environment.

For this study, fantasy was not explored as a motivational factor due to the generic nature of the content. Students were put into the role of a photographer with very exact instructions on

what elements their pictures needed to have. This did not necessarily create an external world where students were fantasizing about being a photographer. Fantasy, in the context of Malone and Lepper's (1987) work, would fit into a science-based game where students have to think like a scientist to solve a medical problem for a fictional country. While fantasy has a role in some games, especially those where players are immersed in the experience, it did not appear to have a good fit in this study.

Cooperation

Some games create the opportunity for players to work together in ways similar to a sports team working together to score points. When students work cooperatively, they have the ability to develop 21st century skill, such as creativity and innovation, critical thinking and problem solving, and communication and collaboration (Partnership for 21st Century Learning, 2015). Gamified experiences give students the ability to development these skills as well as improve independent skills because students can work together to complete multiple game goals simultaneously (Abrams & Walsh, 2014). These experiences also provide the opportunity for players to socially interact to work toward a goal, which is necessary to create and sustain an engaging game (Koivisto & Hamari, 2014). Giving students the option to work together creates an environment where obtaining information can come from a variety of human and technological sources to create a community fund of knowledge and a more enriching experience for learners.

Competition

In team-based games, competition is a motivating factor that drives players to improve their skill above their current abilities or those of their peers. Competition provides players with the motivation to show that they are capable of outperforming their peers when completing an

objective (Banfield & Wilkerson, 2014; Lei, 2010). The ability to move to the top of a ranking list or affect the actions of others playing the game creates an environment where players actively change the tactics they use to play so that they can continuously perform better than their peers (Malone & Lepper, 1987).

When leaderboards, badges, or achievements are used to show mastery, competition can increase since players want to obtain those items to show their abilities and status in the game (Denny, 2013). Several players earning a badge can motivate other players to work to obtain it or find achievements that others may not have. The drive to show who can get more badges and achievements can trigger a friendly competition amongst players and motivate them to continuously improve skills and knowledge to remain at the top of the leaderboard (Bellotti et al., 2013; Denny, 2013).

Recognition

When playing games, achievements and rewards can provide students with recognition for their achievements that may otherwise go unnoticed (Lee & Hammer, 2011). In education, it is important for students to be recognized for their achievements so that they gain confidence and want to continue learning. When students can see and compare achievements with one another, they can improve their social status in a class and show their peers what they are able to accomplish (Montola, Nummenmaa, Lucero, Boberg, & Korhonen, 2009). Students who are recognized for a notable success with a badge or achievement icon can display that to their peers and be noticed socially for their knowledge and skills that might go unrecognized in the classroom setting.

Reward systems, such as badges and achievements, can encourage some students to engage and continue playing a game (Domínguez et al., 2013). However, it does not work for

everybody, especially if players do not want to compete against their peers. Also, rewards earned in game can act as an extrinsic motivator for some students and help them to continue playing a game (Attali & Arieli-Attali, 2015). When students complete a task and are recognized for it, they are able to point to what they are able to do instead of trying to focus on what they cannot do, which improves self-esteem and motivation.

Intertwining of Factors

Each of the internal motivators above was detailed individually, but there are overlaps that naturally occur between them. For example, players on sports teams can be both cooperative with teammates and competitive against other teams simultaneously in order to achieve recognition as the winner of a game. Cooperation and competition coexists in team games and can be viewed as complementing each other instead of as two separate entities. Cooperation can also be used in classroom environments to reduce qualities of competition that negatively affect learning experiences so that learning can occur (Hoover, 2013).

Another example of overlap occurs when observing competition and recognition. Achievements and other recognition tools can lead to competition and make the game more interesting for some students (Denny, 2013). When students have a tangible goal to work towards, they can be motivated to work harder than their peers to achieve it.

Other links may exist between the remaining factors as well. For example, challenge and control may affect each other since games require rules and boundaries but must also allow players the freedom to strategize and take risks (McGonigal, 2011). These factors can have a direct impact on curiosity since constraints on either of them can have an impact on student interest in the game and in learning new material. Another factor that can influence curiosity is cooperation (Steen, 2013). When individuals work with others, they add their experiences and

ideas to a larger knowledge bank and can generate curiosity to find more information. These links can have an impact on internal motivation and the learning of new content.

When designing a gamified curriculum, components may naturally fall into place by looking at them as a sum of their parts instead of as each individual piece. An important item to remember when making a gamified curriculum is not to force these factors to fit together, but to create a complete experience where students have fun while learning (Simoes et al., 2013).

ADDIE Model

The ADDIE model is a five-part design model used to create instructional units based on learner needs (Gagné, Wager, Golas, & Keller, 2005). It is based on the instructional systems development (ISD) process, but focuses on the five major processes that are followed in instructional design (Molenda, 2015). The ADDIE model is considered to be sequential, but designers can move between its components to improve the unit materials. The ADDIE process is also repeated multiple times throughout instructional development so that improvements are made based on findings through classroom use, evaluation, and improvement needs. Figure 2.1 shows the ADDIE model and the links between its major components.

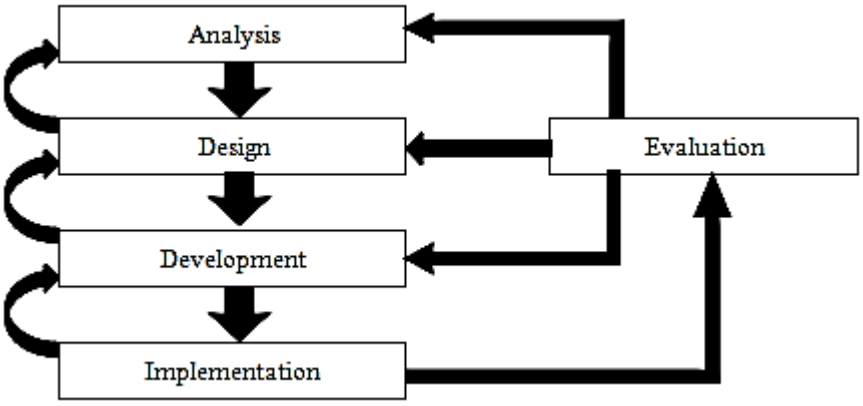

Figure 2.1: ADDIE model for instructional design.

The acronym ADDIE stands for Analyze, Design, Develop, Implement, and Evaluate. In the Analysis phase, the instructional designer determines why the instructional unit is needed and sets instructional goals. The information developed in the Analysis phase informs the steps to be taken in the Design phase, where the designer turns goals into learning objectives, creates a timeline for events, and determines what activities, lessons, and instructional materials will need to be created for the unit. The designer then works on the Development phase, where new, existing, and repurposed instructional material are created to meet the Design needs. After the components of the unit have been developed, the designer moves to the Implementation phase and uses the course materials in a learning environment. During each lesson or after the unit has concluded, the designer moves to the Evaluation phase and reflects on the efficacy of the instructional design. When Evaluation is complete, the designer starts the process over again to improve on the curriculum using the Evaluation results.

The steps in the ADDIE process allow the designer to move back to any phase in order to improve on the lesson design (Gagné et al., 2005). This is important because if the instruction is not appropriate for the age or ability level of the class, students may become disengaged. As new ideas arise to make the unit more engaging, designers can return to the analysis and design phases from later points to introduce new goals and learning material. Also, the designer can move straight from evaluation to design if the same content is being repurposed and no new goals are introduced. With the ability to move linearly through the process or move between steps as needed, the ADDIE model creates a systematic method of instructional design that helps designers to develop effective materials for classroom use.

Benefits of Gamification

In a gamified curriculum, the goal is to create a memorable experience where learners gain and demonstrate new skills in a way that does not feel like learning. A benefit to applying gamification to instructional design is that there is no singular way to do it. For example, an instructor could apply game design elements to an existing unit that would normally be learned through traditional methods, like vocabulary or 21st century skills development (Seaborn & Fels, 2015).

Well-designed game environments have the ability to motivate students, improve learner engagement, and improve student learning (Deterding et al., 2011; Giannetto, Chao, & Fontana, 2011). Gamified environments also work with how the human mind learns and thinks because the player must situate learning in their mind in a way that naturally fits, which does not always happen in traditional school learning (Gee, 2011). Through the use of goals and multiple paths to completion, gamification allows for students to use different thought processes to meet the same goal, which can motivate students to think creatively and improve their performance on tasks (Bíró, 2013; Burguillo, 2010). Through the use of leaderboards and ranking systems, some students may try harder to succeed so that they can be recognized for their skills. Gamifying the curriculum takes students past simply learning facts and requires them to think about and apply content to the learning experience. This can help students to gain a deeper understanding of the material and apply that knowledge to other learning scenarios.

Problems with Developing Gamified Lessons

While developing a gamified curriculum is enticing, it will not automatically fix classroom learning. Two problems with adding gamification to instructional design are that it is used too frequently and that it is superficially added to existing curriculum (Glover, 2013; Hanus

& Fox, 2015). For example, adding leaderboards, badges, or rewards to a unit simply to say that it is gamified may have adverse effects on student learning and cause them to become more extrinsically motivated (Cheong et al., 2014; Hanus & Fox, 2015). Adding game elements without a purpose not only creates superficial benefits to learning, but may also lead to superficial student engagement (Kapp, 2012b). Likewise, gamification should not be used for every learning situation because the novelty effects can wear off and cause students to disengage from the learning process (Hanus & Fox, 2015; Vos et al., 2011). Students may enjoy a gamified curriculum and engage during the first few times a game is played, but may lose interest and motivation to play because the novelty has worn off.

Other problems with gamified curriculum relate to the intrinsic motivations detailed by Malone and Lepper (1987). While friendly competition between students can foster a drive to improve skills, too much competition can have a negative impact on some students (Glover, 2013). High levels of competition can discourage less competitive students from engaging in the learning process because they do not want to seek status or engage in competition with their peers. Gamification may also cause students to value competition over collaboration, which can alienate students from the learning process and impact their education (de-Marcos et al., 2014). Also, reward systems need to be carefully applied so that student learning is more important than the game rewards received. Too much emphasis on external rewards can cause students to play the game for those rewards instead of for the activity itself, which negates the learning benefits expected in a gamified design (Wang & Sun, 2011). This is not to say that there cannot be rewards for playing the game, but the tasks being requested of students must include a reward that is of the same value. Adding too much or too little value to a reward can cause students to become frustrated and disengaged and lead to high extrinsic motivation.

A third notable problem with the application of gamification is that the development of a gamified curriculum requires effort and time to implement. The process of developing a gamified unit is time-consuming and can be difficult to implement correctly (Cheong et al., 2014). If an instructor wants to motivate her students to learn, a great deal of planning must be done to ensure that the experience motivates a wide variety of participants (Dominguez et al., 2013). Developing a curriculum requires seeking out resources to use so that the gamified experience is complete and compelling for students (Lee & Hammer, 2011). Failure to put in time and effort to develop a complete game can lead to superficial learning, disengagement, lack of motivation, and problems found in traditional learning environments.

Using a gamified curriculum in a classroom has the potential to improve student engagement, motivation, and learning if it is applied properly. Instructional designers will need to be prepared for many problems that can arise during development and implementation of their gamified lesson so that students are interested in the game. If the gamified instruction is carelessly developed or missing game design elements, it can be ineffective in motivating students to learn and have a negative impact on student achievement.

Gamification in Classroom Settings

Many recent studies have shown how gamification has been applied successfully to learning environments. One study found that changing the structure of a course into a competitive game had a strong impact on helping students learn their educational identity (Charles et al., 2010). The researchers found that students who played the game and received feedback for their actions enjoyed the experience more, learned more, and had lower rates of failure than members in class sections from previous years. In another study, students noted that they were more motivated and interested in a gamified course compared to other courses they

had taken (Barata et al., 2015). These students were also more proactive and willing to participate in a gamified course compared to their non-gamified courses. Ibáñez, Di-Serio, & Delgado-Kloos (2014) found that gamification helped students to develop knowledge in a programming course. The course was developed using leaderboards and badges that were visible to peers and were earned by completing specific tasks. Abrams and Walsh (2014) found that students who took part in a gamified vocabulary unit were moved to practice words on their own because they were engaged in learning through gameplay. The common thread throughout these studies is that students were intrinsically motivated to learn and found enjoyment in the act of learning.

While not all gamified experiences are successes, researchers have found that games have positive effects on student learning. For example, Vos et al. (2011) found that using game design elements have the capability of enhancing student motivation and critical thinking while playing the game. Carefully selecting game elements that align with learning content can improve student learning outcomes and help them develop motivation to learn. Another study found that some students may benefit from mechanisms that show progress, such as progress bars or completion percentages, because students can view their progress and view feedback to improve their status (Chen, Chao, Hsu, & Teng, 2013). Other systems have been generated that address fairness in group work. For example, one study discussed how a game platform encouraged students to contribute and collaborate (Moccozet, Tardy, Opprecht, & Leonard, 2013). Although students were grouped together, each student had to show personal contributions to the gamified experience to benefit the whole team. This helped to reduce the amount of students who were passively participating in the activity and allowing others to do their work for them.

In all, recent research has shown that gamification is a viable tool for improving student learning and increasing motivation. Studies have found that intrinsic motivation increases with the introduction of gamification to a curriculum (Banfield & Wilkerson, 2014; Lamprinou & Paraskeva, 2015), and that the increase in intrinsic motivation can improve learning achievement (Su & Cheng, 2014). With the novelty that gamification offers and the motivation it provides for students to learn new content, gamification should be explored more fully to determine what qualities of games create the best game design.

Gender Considerations in Gamified Design

When developing a gamified experience, research suggests that male and female students have different motivations to learn based on the environment they are in. For example, female students tend to enjoy the social benefits of games more than male students (Koivisto & Hamari, 2014), which would suggest that female students are intrinsically motivated by cooperation more than males. Females also tend to be more autonomous than males, which may cause females to have better engagement, higher intrinsic motivation, and better achievement in academic activities (Vecchione et al., 2014). It can be inferred that female students need control over their learning to be intrinsically motivated. Male students, on the other hand, may be more driven toward tangible rewards for academic performance and use these to show class status (Vecchione et al., 2014). Male students may be intrinsically motivated by competition and recognition, which means that these factors would need to be present in gamified design to engage them in learning.

While these studies provide some guidance as to what qualities need to be present in a gamified experience, there is a general lack of information that describes what game elements need to be present to engage male and female students specifically.

Photography Skills and Education

Photography has been used as a medium to convey information to viewers for almost 200 years (Horner, 2016). Through this time period, photographers have taken pictures of many items of interest, including wars, protests, and major events that have impacted human culture. Every image ever captured by a professional or amateur photographer was taken because the subject of the photo was interesting and motivated them to take high-quality photos to remember an experience.

Photography has a broad range of uses and can help students learn more about content or find a different perspective from their own, which makes it useful to learn and apply in classroom settings. For example, Siegle (2012) explained that using photography to enhance student projects allowed members of a classroom community to learn more about each other and express themselves beyond speaking and writing. Lilly and Fields (2014) also noted that combining photos taken by students with writing led to improved composition, including organization of thoughts and writing mechanics. The inclusion of a visual method of communication can help students to more completely explain their thought process and improve other skills that are developed in the classroom.

Since photographers are motivated to take good pictures, learning photography skills needed to take good pictures can be used to motivate students to learn other content and improve learning outcomes. When students take pictures as part of an educational lesson, they are able to choose how they represent their learning and can find value and enjoyment in the process (Horner, 2016). Learning photography skills can help motivate students to develop other skills, including creativity and decision making skills, which can be applied to careers in the changing job market.

Summary

The purpose of this study was to determine which of the intrinsic motivational factors described by Malone and Lepper (1987) are required to develop a gamified experience for students. If a gamified lesson is to be deemed effective, Malone and Lepper (1987) and Kapp (2012b) suggested that the intrinsically motivating factors of challenge, curiosity, control, cooperation, competition, and recognition need to be addressed in the design phase. However, it is unclear which of these motivating factors are absolutely necessary to create an engaging experience where students are intrinsically motivated to learn. A gamified photography unit was used in this study to determine which factors of the Taxonomy of Intrinsic Motivations for Learning (Malone & Lepper, 1987) correlate with scores obtained on a test of photography skills learned during the game. The findings of this study were used to determine which factors correlate with student success and develop a template for creating gamified experiences for classroom use. This study also aimed to determine which intrinsically motivating factors were specific to student success based on gender. Results of this study were used to determine whether there were specific differences in intrinsic motivations between female and male students so that intrinsically motivating gamified experiences can be made to fit their needs. Specifically, the following research questions were addressed:

1. In a gamified learning experience, which combination of intrinsically motivating factors from the Taxonomy of Intrinsic Motivations for Learning (challenge, curiosity, control, cooperation, competition, and recognition) best predicts a participant's score on a photography skills assessment?
2. Which combination of intrinsically motivating factors best predicts photography test scores for female students?

3. Which combination of intrinsically motivating factors best predicts photography test scores for male students?
4. Which motivational variables have a direct or indirect effect on participant's scores on a photography skills assessment?

The structure of this study can be found in Figure 2.2 below.

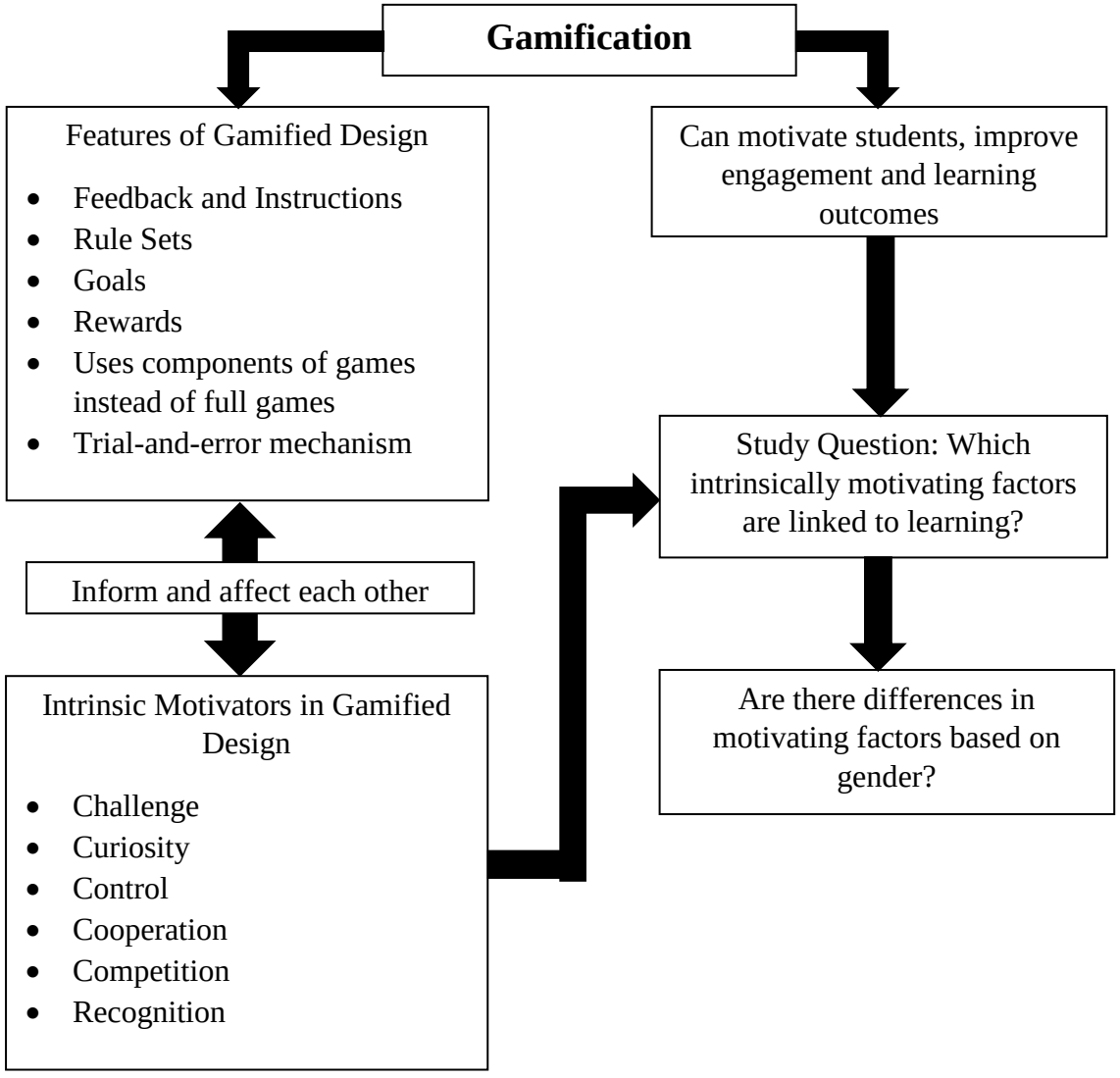

Figure 2.2: Overview of the gamification study.

Chapter 3 – Method

Introduction

For this study, a gamified unit on photography was developed for use in a middle school classroom. The purpose of this study was to determine which intrinsic motivators predicted scores on a photography skills test that students learned while playing a game. This chapter begins with a description of the participants used in this study. Next, the gamified unit and its links to Malone and Lepper's Taxonomy of Intrinsic Motivations for Learning (1987) are explained. The explanation of the gamified unit is followed by an overview of the Intrinsic Motivations Survey and photography skills assessment developed for this unit and used for data collection. Then, a timeline of the gamified unit and the expected class activities are detailed. Finally, the data analysis procedures for the study are explained, including information about how the unit test and Intrinsic Motivations Survey data will be used to answer the study questions.

Participants

Participants for this study were middle school students from an urban middle school who were enrolled in a semester-long communications media class. The students in this class were learning photography and videography skills that were used in other course projects. Participants who took part in this study were in the 7^{th} and 8^{th} grade and displayed a variety of academic and photography skill levels.

In total, 146 participants were used in the study, including 63 females and 83 males. The G*Power statistical calculator suggested that at least 111 participants were necessary to obtain an effect size of .20. To obtain the desired number of participants, the study was conducted over

two consecutive semesters of a course where students learned photography skills. There were 69 participants from the spring semester and 77 participants from the fall semester.

Creating a Gamified Photography Unit Using the ADDIE Model

For this unit, a new game called CLICK was developed by the researcher to teach photography skills to students. The skills that students learned during the gamified unit were used throughout the course in projects that may be seen by parents, students, and school personnel. The ADDIE model was used to guide the instructional design process to ensure that engaging content was developed for this unit. A brief overview of the ADDIE design for this unit is in Table 3.1.

Table 3.1 - ADDIE Design for Photography Unit

Analysis	Develop goals for the unit 1. Teach students the basic principles of photography, including rule of thirds, composition, shot types, and shot distances 2. Create a gamified experience to teach the basic principles of photography.
Design	Decide on learning objectives, a timeline of events, and instructional materials to be developed. 1. Learning objective – teach students basic photography principles using a gamified learning design. 2. Timeline of events – two weeks 3. Find a rule set to use to develop the game 4. Instructional materials – unit test, Intrinsic Motivations Survey, basic photography guidance page, rules and guidance for game play, list of pictures to take for each round
Development	Develop the gamified experience based on design needs. 1. Create rules and guidance for the game. Build this based off of the rules for the game HORSE. 2. Create a guidance page with information on shot types, distances, composition, and rule of thirds that students will reference during the game. 3. Develop the unit test based on the guidance page. 4. Create the Intrinsic Motivations Survey.
Implement	Play the gamified unit with the class. Make minor adjustments without changing the core structure of the game.
Evaluation	Evaluate the efficacy of the gamified unit using test data and survey feedback. Make decisions about changes to goals and design that need to be done to improve the game.

In the analysis phase, the researcher identified learning goals that justified the use of gamification in the classroom. The main goal of this unit was to teach students photography skills that could be applied to class projects and extended to videography skills later in the course. Smaller goals related to the main goal were to teach students the rationale and application of the rule of thirds, composition basics, shot types, and shot distances. A second goal for this unit was to use gamification to create an engaging experience that students would enjoy.

During the design and development phases, the photography unit was created that incorporated game design elements and Malone and Lepper's Taxonomy of Intrinsic Motivations. The first component in designing the game was to determine what existing rule sets could be modified to fit the game (McGonigal, 2011). The basketball skills game HORSE was selected to develop the rules and structure for CLICK. While CLICK draws from HORSE in regards to the points system, there were several significant changes that were made so that the experience would better fit the unit. For example, students want to avoid earning letters while playing HORSE, but want to earn letters while playing CLICK. While earning letters in HORSE puts the player closer to losing the game, players want to earn letters toward spelling CLICK in order to win the game. Another modification to the structure of HORSE was that every student was required to take the same shot at the same time. If students were challenging another team to take the same shot as them, the game could last significantly longer and students may lose interest over time. To keep the game interesting over multiple rounds, students who won the previous round had the option to choose the shot criteria for the entire class, including themselves, to complete.

Integration of Motivational Factors

In order to make the game experience engaging and motivating for students to play, the unit was designed using Malone and Lepper's Taxonomy of Intrinsic Motivations for Learning (1987). Each of the six intrinsically motivating factors (challenge, curiosity, control, cooperation, competition, and recognition) was consciously integrated when creating the game experience.

Challenge. Challenge was addressed through the rules, goals, and feedback embedded in the game design. As mentioned earlier, the rules were modified from the game HORSE so that students had specific guidelines to follow to make the game fair. The goal of the game was to earn a point by taking the best photo each round that met established criteria, which in turn led to the larger goal of winning the game. At the end of each round, each picture was given specific, targeted feedback about the good and bad qualities of the photo that could be used to improve skills in later rounds. This feedback targeted common errors in photography, such as cutting off subjects, distance issues, and lighting and shadowing problems, and were expected to be fixed in future rounds.

Curiosity. Curiosity was embedded in the gamified design because students were required to develop new skills and expand on them in short time periods. Students who were novices in the first round were able to improve their skills through experience in later rounds by exploring new techniques and applying information they learned from text and peer guidance. The natural curiosity to improve skills due to the skill level increase of their peers may have motivated students to take better photos each round. Uncertain outcomes also played a factor in student curiosity because students did not know if they took the best picture until they saw theirs compared to others in the class. Students were not aware of their shot quality compared to others

until they were shown all pictures through a projector, which created motivation to take several good pictures and submit the best from that sampling.

Control. Control was established in this game based on how teams chose to complete the objective for each round. The criteria for each shot was purposefully vague so that students had a choice as to what they took a picture of, but included enough constraints so that comparisons could be made between similar pictures. This allowed students to turn in unique photos that did not look exactly the same as their peers, but contained the same elements so that comparisons could be made in shot qualities. While students were required to follow a strict set of rules, they were not confined to producing a single solution to meet round goals and could choose how their picture met the criteria for that round.

Cooperation. Cooperation was built into the gamified design through the use of self-selected pairs. The pairs were able to collaborate to make decisions about the composition of their photo to improve their chance of success each round. They were also required to collaborate with other teams to complete certain tasks such as taking a photo with two or more people in the shot. Working with a partner provided students with the opportunity to develop more creative solutions and turn in a better picture.

Competition. Since the ultimate objective of the game was to win, students competed against other teams for points each round. As the goal of the game was to improve skills each round, the competitive aspect of the game created a natural drive for each team to want to do better than those around them. This friendly competition helped students to improve their skills quickly so that they could remain competitive throughout the game.

Recognition. Finally, recognition was used to praise students for their successful application of photography skills when pictures were shown to the class and compared against

each other. Along with providing focused feedback on each picture about what to improve and what was done well, students were recognized for the good qualities of their photos and were provided with a chance to take pride in their work and have it seen by others. Student work was recognized each round with verbal praise and through the distribution of points.

With these six design principles in mind, it was expected that students would enjoy taking part in the game and be intrinsically motivated to play. One reason for this was because the gamified curriculum allowed students to take risks, try new skills learned during previous rounds, and test their skills against their peers. By taking a photography unit and turning it into a game, students had the opportunity to learn while playing instead of learning while working. A detailed rule set for the game CLICK can be found in Appendix A.

Instruments

During the development phase, two instruments were created to collect data for this study. The first instrument was the Intrinsic Motivations Survey, which asked participants questions about the six intrinsic motivating factors they encountered while playing the game. The second instrument was a photography skills test that measured student knowledge of photography principles learned during the game.

Intrinsic Motivations Survey

The Intrinsic Motivations Survey was developed by the researcher and included questions based on the six motivational factors originally introduced by Malone and Lepper (1987) and discussed by Kapp (2012b) as necessary for designing engaging and motivating gamified lessons. The six motivational factors that were measured in the study included (a) challenge, (b) curiosity, (c) control, (d) cooperation, (e) competition, and (f) recognition. At the beginning of the survey, three general questions about student views on using games for learning were asked.

These introductory questions were followed by questions on the six motivational factors found in gamified design.

The survey contained six sections based on each intrinsic and interpersonal motivation, and each section included six questions that were measured using Likert-type scales. The questions and responses were put into a grid so that participants could easily identify which responses they wanted. Participants responded to each question by placing an X in the table across from the question and below their response. The response options were very strongly disagree (VSD), strongly disagree (SD), disagree (D), agree (A), strongly agree (SA), and very strongly agree (VSA). The responses provided by participants were changed to a numerical value, with VSD scored as a zero and VSA scored as a five. Scores for each block were added together so that total scores for each section could be analyzed against each other. The highest possible score for each section was 30 points.

Following the advice of Krosnick and Presser (2010), each question stem in this survey was made using a positive statement. This was important to do because adolescents may not be cognitively able to answer negative statements in an affirmative manner, which could cause them to give the opposite answer they intended (The London School of Economic and Political Science, 2010). For example, adolescents who are provided with negatively-worded stems may answer with agree when they meant to answer with disagree. Therefore, negatively-worded stems were not used so that errors were avoided in intended responses (Colosi, 2005).

At the end of the survey, students were asked to provide some demographic information, including gender, ethnicity, and perceived photography skill at the start of the game. Students were provided with an area where they could write their thoughts and feelings about the game or any information that was not asked in the survey. Students were also provided with five focused

questions at the end of the survey that asked them about what they enjoyed, disliked, found easy, found difficult, and other feelings and emotions they felt during the course of the game. The answers provided by participants were used to understand trends in survey responses. The Intrinsic Motivations Survey can be found in Appendix B.

Since the survey was a new instrument developed for this study, a pilot study was conducted to determine reliability of the instrument. Factor analysis was conducted to determine what, if any, underlying structures existed between the questions developed for the six predictor variables used in this study (challenge, control, curiosity, cooperation, competition, and recognition). Factor analysis was conducted on 47 random surveys and included eigenvalue, variance, scree plot, and residual analysis. From the analysis, a seven-component solution was generated that accounted for 79.4% of total variance for responses from all variables, which would suggest that the survey was reliable for use in this study.

The survey was also examined to determine if it had validity (Sprinthall, 2012). Dr. Curby Alexander of Texas Christian University was asked to review the survey due to his expertise in gamification. In his review, he noted that the survey had face validity because it measured the constructs associated with gamification. However, he expressed concern with the second question in the control section. Dr. Alexander felt that the stem “I felt like I was doing what I wanted to do each round” was vaguely worded and felt that it could be misleading. Attempts to change the wording of the stem made it sound like it would measure another motivational factor in the survey, so the wording was not changed.

Photography Skills Test

The test of photography skills used in this study was developed based on the material students learned during the game. The test consisted of ten matching questions, eight multiple-

choice questions, six fill-in-the-blank questions, and two long answer/constructed response questions. Questions were developed based on the photography skills guidance that was given to students before the game began. The highest possible score that students could earn on the test was 70 points. The test can be found in Appendix C, and the photography skills guidance used to develop the test can be found in Appendix D.

Procedure

Prior to delivering the gamified unit to students, the study design and population was approved by the University of Nevada, Reno, Institutional Review Board. After the study was approved, students were sent home with a consent form to be signed by parents. This was provided one week before the study began so that parents, guardians, and students had the opportunity to read about the study, ask clarifying questions, and consider participation in the study before the gamified unit began. On the day the unit began, students were read a script detailing the study and asked to provide verbal assent of their willingness to participate in the study. Students who provided assent and obtained consent from parents and guardians were marked down on a class roster so that their data would be used in the results analysis. Students who did not provide consent or assent were not marked on the roster, but still participated in the gamified unit so that they had the ability to complete future projects that used the skills learned during the game.

Partner Selection

On the first day of the study, students chose a partner to work with for the duration of the game. Students were allowed to select their partner because prior research has shown that self-selected groups tend to perform better and have better experiences than randomly-assigned groups in short-term activities (Chapman, Meuter, Toy, & Wright, 2006; Moreland, Levine, &

Wingert, 1996). Students in short term activities also may not be able to overcome differences in learning styles and cultural factors before the activity ends, which may have a negative impact on learning (Rientes, Alcott, & Jindal-Snape, 2014). Study participants were also able to select a partner from students who did not receive parental consent to participate so that they could play the game with a person they were familiar with.

Delivery of Photography Guidance and Rules

Once students selected their partner, they sat next to each other so that they could be marked down in an Excel spreadsheet for scorekeeping purposes. Next, each pair was given a guidance sheet that included information about composing photographs, including shot distances, framing, angles, image orientation, and other basic photography information. Students were given ten minutes to go over the information with their partner so that they had a base understanding of the shot criteria they used each round. The guidance sheet can be found in Appendix D.

After 10 minutes, students were given the rules of the game. An information sheet was provided to each pair of students so that they could familiarize themselves with the rules and goals of the game as well as how to win. The information was also put into a presentation so that the teacher could explain the rules and provide opportunities for students to ask clarifying questions. Each pair of students was assigned one iPad to take all of their pictures so that pictures could be stored and transferred to the instructor's iPad for post-round evaluation. The rules and information sheet for the game CLICK can be found in Appendix A.

Game Flow

For the first round of the game, the instructor provided shot criteria that each pair was required to use in their photo. Every pair was given the same initial shot criteria, which was

"Take an eye-level mid-shot portrait of one of your group members." Students were given five minutes to reference the guidance sheets they were provided and decide the best shot to compose with their partner. Students used the Camera app on the iPad, but could not zoom in or use photo options such as square or panorama. Students were also prohibited from altering their photo using camera tools or editing programs. When students were confident that they had composed their best picture, they transferred their picture from their iPad to the instructor's iPad using the Airdrop function. This allowed students to submit their photos anonymously so that there was fairness in the photo evaluation process.

When all pairs had submitted their photos or the submission time period had expired, the instructor displayed the photos on a large screen by transmitting them from the iPad using the AirServer app to the school computer and projector. As each picture was shown on the screen, the instructor highlighted strengths and weaknesses of each photo based on the handout guidance students were expected to use. Students who met all of the round criteria were awarded with one letter toward the word CLICK and one photo was determined the overall winner of the round.

For the next several rounds, teams were given new shot criteria determined by the instructor. This helped to ensure that students received criteria for every shot type, angle, and distance that would be evaluated on the photography skills test and used in later class projects. There were instances in some class sections where one pair of students was able to complete CLICK and a new game was started. During that game, the pair with the overall best picture in the previous round was given the opportunity to decide shot criteria for the class to use for the next picture. The game was played over seven days, which included four 40-minute class periods and two 80-minute class periods.

Survey and Test Delivery

On the eighth day of the study, each student was given the Intrinsic Motivations Survey to complete individually. Students were given 40 minutes to complete the survey so that they had time to think about and provide feedback about their motivation to learn and experiences in the gamified unit. On the final day of the study, students were given an unannounced test on the photography skills learned during the game. Students were not notified of the test beforehand so that there was a reduced chance that they would study outside of class or seek out additional materials that would give them an advantage over their peers and interfere with the reliability of the findings in this study. Students were given a complete block period of 80 minutes to finish the test.

In total, the game, survey, and test took nine class periods to complete. The study took place over six 40-minute class periods and three 80-minute block periods. An implementation log that details the game process can be found in Appendix E.

Data Analyses

After tests and surveys were administered, data was analyzed using multiple regression and maximum likelihood estimation (ML) SEM techniques. Multiple regression analysis was selected to analyze the first three study questions. These study questions were:

1. In a gamified learning experience, which combination of intrinsically motivating factors from the Taxonomy of Intrinsic Motivations for Learning (challenge, curiosity, control, cooperation, competition, and recognition) best predicts a participant's score on a photography skills assessment?
2. Which combination of intrinsically motivating factors best predicts photography test scores for female students?

3. Which combination of intrinsically motivating factors best predicts photography test scores for male students?

Multiple regression analysis was selected because it can produce an equation that maximally correlates a combination of predictor variables with a single criterion variable (Mertler & Vannatta, 2013). The predictor variables for each multiple regression were challenge (X_1), control (X_2), curiosity (X_3), cooperation (X_4), competition (X_5), and recognition (X_6) and the criterion variable was the score on a photography skills assessment (Y). The variables and descriptions can be viewed in Table 3.2.

Table 3.2 - Variables Used in Multiple Regression

Variable	Variable Description
Y	Score on a photography skills test
X_1	Challenge
X_2	Curiosity
X_3	Control
X_4	Cooperation
X_5	Competition
X_6	Recognition

The first study question included all study participants to discover which combination of intrinsic motivational factors correlate with test scores in a mixed-gender classroom. Since many classrooms have a mixed-gender population, the results for this question could be used to determine which intrinsically motivating factors need to be considered when developing a gamified experience that would motivate learning and growth for both genders.

The second and third study questions were analyzed using multiple regression analysis, but participants were limited to the gender noted in each question. The findings for these questions could be used to determine which combination of intrinsic motivational factors is most important to consider when developing gamified instruction for specific genders. While the findings of these questions may not apply to school settings, they may be useful for gender specific camps and learning experiences outside of school.

While Malone and Lepper (1987) and Kapp (2012b) noted that all of the six factors need to be present to develop fun and engaging gamified content, this study is expected to find which intrinsically motivating factors must be addressed when designing a gamified curriculum and which can be considered optional. If it can be determined which mix of factors produce high levels of motivation to participate in learning and perform well on assessments, teachers and researchers can use this information to create gamified units that engage all students in learning new material.

Finally, the fourth question was analyzed using the SEM analysis of maximum likelihood estimation (ML) with the STATA/SE 14.2 statistical analysis software. The fourth study question was: *Which motivational variables have a direct or indirect effect on participant's scores on a photography skills assessment?* ML was selected because it estimates the likelihood that the data matches to the maximum extent with the population it was drawn from (Berkout, Gross, & Young, 2014; Kline, 2011). Using research based on connections between the six motivational variables, a theoretical model was developed linking the predictor variables to each other and to the criterion variable. Figure 3.1 shows the theoretical model generated from prior research on the motivating factors used in this study and Table 3.3 shows the intrinsically motivating factor that relates to each label on the figure.

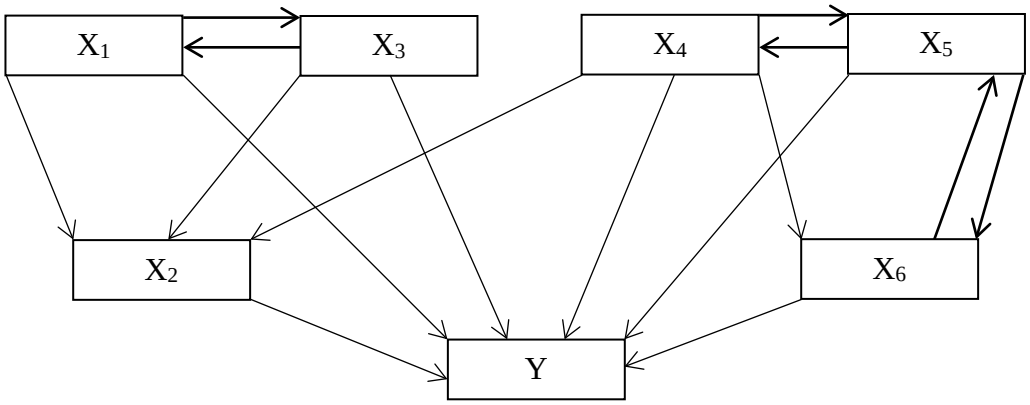

Figure 3.1: Conceptual model of variable relationships.

Table 3.3 – Variable Descriptions for Conceptual Model

Variable	Variable Description
Y	Score on a photography skills test
X_1	Challenge
X_2	Curiosity
X_3	Control
X_4	Cooperation
X_5	Competition
X_6	Recognition

The conceptual model was analyzed using four goodness-of-fit statistics to determine if the model was a good fit for the data. The statistics used were the model chi-square, the root mean square error of approximation (RMSEA), the Bentler Comparative Fit Index (CFI), and the Tucker-Lewis index (TLI).

First, the model Chi-square was used to test the exact-fit hypothesis that there are "no discrepancies between the population covariances and those predicted by the model" (Kline,

2011, p. 199). The goal of this statistic is to create a model where the statistical significance of the exact-fit hypothesis is much higher than $p = .05$. Second, RMSEA was used to determine goodness-of-fit based on a parsimonious model (Kline, 2011). The goal of this test was to reach a value less than .05, which would indicate that the model is a good fit for the data. Finally, CFI and TLI were selected because they measure whether the final model is an acceptable fit to the data compared to the initial model (Cangur & Ercan, 2015; Kline, 2011). The minimum value that these statistics should have to indicate that the model fits the data is .90 (McDonald & Ho, 2002). However, Cangur and Ercan (2015) advised that values for these two measures need to be larger than .97.

Summary

In this chapter, a gamified unit was detailed for use in the classroom. The chapter started with information about a gamified photography unit and how the six predictor variables (challenge, control, curiosity, cooperation, competition, and recognition) were applied to the design. Based on the gamified unit, a photography skills test was developed to measure learning that took place during gameplay. An Intrinsic Motivations Survey was also developed to discover how students felt about each intrinsic motivator represented in the game. Next, a detailed procedure was provided that explained how the gamified unit was delivered to students and how the game should be played, including variations of the game that can be implemented to keep students interested when more than one complete game is played. Finally, data analysis procedures were detailed to show how data from the test and survey would be used to answer the questions addressed in this study.

Chapter 4 - Results

Introduction

After survey and test data were collected, data analysis was conducted to explore relationships between the intrinsically motivating factors and test scores. Data analysis was done using multiple regression and SEM modeling to discover which predictor variables had direct and indirect effects on test scores. This chapter begins with information about data screening and the results of a Mann-Whitney U test to determine if there were significant differences in median scores on survey responses between the spring and fall semester groups used in this study. Next, the introductory survey questions were analyzed to show descriptive data about participant's views of using games as learning tools. Then, the results from the multiple regression analyses used to test the first three study questions were detailed. Finally, the steps taken to generate a model using the maximum likelihood estimation for SEM were explained. The steps include the statistical data used to determine the goodness-of-fit of the model to the test and survey data and rationale behind each alteration.

Data Screening

During the course of the study, test and survey data were collected from 146 students between the spring and fall semester groups. Each survey was screened for missing data in the six blocks of questions for each motivational variable. Thirteen participants were removed from analysis because they had at least one question missing in a block, which affected the overall calculated score for that variable. Data replacement using series mean was not done because it may not provide a score that accurately reflects what the student would have entered for that specific question and could affect the overall variable score. After the data from these

participants were removed, data from 133 participants remained for analysis, including 59 from the spring semester and 74 from the fall semester.

Since data was collected across two semesters, an independent-samples Mann-Whitney U test was conducted to determine if there were differences in median scores in responses between the spring and fall semester groups on each question in the study. The Mann-Whitney U test was selected because the data collected from students in the fall and spring semester classes had uneven sizes and normality of data could not be assumed (Sprinthall, 2012). Each question tested returned a p-value greater than .05, which would indicate that there were no significant differences in median scores between the spring and fall semester groups. These findings indicate that the data from both semesters could be combined for analysis. Table 4.1 shows the results of the Mann-Whitney U test.

Table 4.1 – Significance of Survey Questions between Groups

Variable	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6
Challenge	.174	.561	.909	.915	.238	.133
Curiosity	.842	.666	.224	.917	.609	.064
Control	.620	.682	.730	.679	.273	.416
Cooperation	.546	.284	.148	.710	.566	.835
Competition	.620	.307	.473	.666	.382	.185
Recognition	.731	.948	.413	.985	.715	.359
Significance - $p = .05$						

Descriptive Data for Opening Survey Questions

The first three questions of the survey asked students if they enjoyed playing the game, if they felt that playing the game was a good way to learn content, and if playing games would help them to remember content longer. Data analysis showed that 124 of 133 students (93%) enjoyed playing the game, 125 of 133 (94%) agreed that playing the game was a good way to learn about photography, and 124 of 133 (93%) agreed that using games to learn would help them remember content longer. Table 4.2 shows the response frequency for each question.

Table 4.2 – Frequency of Responses to Opening Survey Questions

Question	VSD	SD	D	A	SA	VSA
I enjoyed playing this game.	2 (1.5%)	3 (2.3%)	4 (3.0%)	35 (26.3%)	35 (26.3%)	54 (40.6%)
I thought that playing the game was a good way to learn content	1 (0.8%)	2 (1.5%)	5 (3.8%)	37 (27.8%)	48 (36.1%)	40 (30.1%)
I feel that playing a game to learn new content will help me remember it longer	1 (0.8%)	0 (0.0%)	8 (6.0%	36 (27.1%)	44 (33.1%)	44 (33.1%)

Data Analysis and Results

Prior to conducting data analysis, Mahalonobis Distance was calculated to find outlier data. A critical chi-square value of $df(6)_{.001} = 22.458$ was used to test for outlier scores. Two scores had chi-square values higher than the critical threshold and were removed from further analysis, which reduced the number of valid participants to 131.

Results for Research Question One

The first research question posed in this study was: *In a gamified learning experience, which combination of intrinsically motivating factors (challenge, curiosity, control, cooperation, competition, and recognition) best predicts a participant's score on a photography skills assessment?* Multiple regression analysis was used to develop a model using the six intrinsically motivating factors as criterion variables and scores on a photography skills assessment as the predictor variable. Multiple regression analysis was conducted using two methods.

Enter method. The first multiple regression analysis was conducted using the Enter method of variable entry. This method was selected to determine how a combination of all predictor variables predicts test scores (Mertler & Vannatta, 2013). A significant model was developed using all six predictor variables [$F(6, 124) = 3.058$, $p = .008$, $R^2_{adj} = .087$], but only one predictor variable, curiosity, was found to be a significant predictor of test scores in the

model (p = .001). Table 4.3 shows the coefficients and significance of each variable in this model.

Table 4.3 - Coefficients for Question One Enter Method Model

	B	*β*	*t*	*p*
Challenge	-.349	-.159	-1.087	.279
Curiosity	1.186	.588	3.391	.001*
Control	-.552	-.294	-1.707	.090
Cooperation	-.110	-.079	-.825	.411
Competition	.463	.255	1.765	.080
Recognition	-.339	-.194	-.977	.331
* = significant at p = .05				

From this data, the following multiple regression equation was generated using standardized coefficients (β):

$$Z_{Score\ on\ a\ Photography\ Skills\ Assessment} = .588Z_{curiosity}$$

Forward method. Due to the low number of significant predictor variables found using the Enter method, a second analysis was done using the Forward method of variable entry. A significant model was generated with two predictor variables: curiosity ($p < .001$) and control ($p = .01$). The second model was also found to be significant [$F(2, 128) = 6.632$, $p = .002$, $R^2_{adj} = .080$]. Table 4.4 shows the coefficients table for this model.

Table 4.4 - Coefficients for Question One Forward Method Model

	B	*β*	*t*	*p*
Curiosity	1.032	.512	3.607	<.001
Control	-.695	-.370	-2.605	.010

From these results, the following multiple regression equation was generated using β coefficients:

$$Z_{Score\ on\ a\ Photography\ Skills\ Assessment} = .512Z_{Curiosity} - .370Z_{Control}$$

Results for Research Question Two

The second question explored in this study was: *Which combination of intrinsically motivating factors best predict photography test scores for female students?* A multiple

regression analysis was conducted to determine which combination of predictor variables predict test scores for female students. Test and survey data from 55 female students were used to attempt to develop a model.

The Enter method of variable entry was used to attempt to create a model predicting test scores, but the model generated was not significant [$F(6,48) = .674$, $p = .671$, $R^2_{adj} = -.038$]. All six variables entered into the model were found to not significantly predict test scores. Table 4.5 shows the coefficients for the variables entered into this model.

Table 4.5 - Coefficients for Question Two Enter Method Model

	B	*β*	*t*	*p*
Challenge	.107	.060	.197	.845
Curiosity	.593	.394	1.027	.309
Control	-.447	-.298	-.909	.368
Cooperation	-.168	-.161	-1.055	.297
Competition	.259	.177	.802	.426
Recognition	-.264	-.187	-.580	.565

A second analysis was attempted using the Forward method of variable entry to determine if any combination of variables could create a predictive model, but a model could not be generated. Since there were no significant variables discovered using the Enter and Forward methods, a multiple regression equation could not be produced to predict test scores for female students.

Results for Research Question Three

The third question explored in this study was: *Which combination of intrinsically motivating factors best predicts photography test scores for male students?* A third multiple regression analysis was done that included test and survey data provided by male students only. Test and survey data from 76 male students were used to develop the model.

Enter method. The Enter method was selected to generate the first model for male students. A significant model was generated using all six predictor variables [F (6, 69) = 2.648, p

= .023, R^2_{adj} = .116], but curiosity was the only significant predictor of test scores (p = .003). Table 4.6 shows the coefficients table for this model.

Table 4.6 - Coefficients for Question Three Enter Method Model

	B	*β*	*t*	*p*
Challenge	-.456	-.187	1.087	.281
Curiosity	1.508	.630	3.117	.003
Control	-.582	-.277	-1.280	.205
Cooperation	-.039	-.024	-.178	.859
Competition	.722	.357	1.732	.088
Recognition	-.567	-.294	-1.083	.283
* = significant at p = .05				

Using these results, the following multiple regression equation was generated:

$$Z_{Score\ on\ a\ Photography\ Skills\ Assessment} = .630Z_{Curiosity}$$

Forward method. Due to the low number of predictor variables used in the first model, a second model was generated using the Forward method of variable entry. A significant model was generated [F (2, 73) = 6.019, p = .004, R^2_{adj} = .118] using the predictor variables curiosity (p = .001) and control (p = .036). Table 4.7 shows the coefficients for this model.

Table 4.7 - Coefficients for Question One Forward Method Model

	B	*β*	*t*	*p*
Curiosity	1.316	.550	3.420	.001
Control	-.720	-.342	-2.131	.036

From this information, the following multiple regression equation was generated:

$$Z_{Score\ on\ a\ Photography\ Skills\ Assessment} = .550Z_{Curiosity} - .342Z_{Control}$$

SEM Model Analysis for Question Four

The fourth question explored in this study was: *Which motivational variables have a direct or indirect effect on participant's scores on a photography skills assessment?* The maximum likelihood estimation method (ML) of SEM was used to determine if a theoretical model provided a good fit for the data collected (Kline, 2011). The theoretical model was built based on prior literature linking predictor variables to each other. The model and data from the

survey and test were entered into the STATA/SE 14.2 statistical analysis software program to test the hypothesized model.

For each model change, several statistics were referenced to determine if the adjusted model was a good fit for the data and if more changes were needed. The goodness-of-fit statistics referenced were the model chi-square (Model χ^2), the root mean squared error of approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). For the model to be a good fit, each statistic needed to meet specific threshold values. The RMSEA needed to be less than .05 and the CFI and TLI values needed to be greater than .97 (Cangur & Ercan, 2015; Kline, 2011; McDonald & Ho, 2002). The chi-square value also needed to have a value as close to zero as possible and a p-value greater than .05 to accept the exact-fit hypothesis (Kline, 2011).

Prior to the model analysis, preliminary correlations were conducted on the six predictor variables and one criterion variables used in the conceptual model. Findings revealed that there were significant correlations between the predictor variables at the $p < .01$ level, but only one predictor variable, curiosity, was correlated with test scores ($p = .014$). The correlation values can be found in Table 4.8.

Table 4.8 - Preliminary Correlations from Initial Model

	X_1	X_2	X_3	X_4	X_5	X_6	Y
X_1	1.000						
X_2	.790 **	1.000					
X_3	.752 **	.805 **	1.000				
X_4	.404 **	.404 **	.458 **	1.000			
X_5	.660 **	.703 **	.709 **	.351 **	1.000		
X_6	.728 **	.821 **	.838 **	.460 **	.807**	1.000	
Y	.080	.214 *	.043	-.040	.171	.096	1.000

** = significant at $p < .01$ * = significant at $p < .05$

The first test of the conceptual model found that the model could not be estimated. To remedy this, one arrow was removed from variables that had two single-headed arrows between

them so that the STATA/SE 14.2 software could develop an initial estimated model. Arrows were removed from control to challenge, recognition to competition, and competition to cooperation so that only one arrow connected each pair of variables. These changes allowed the program to produce an estimated model with the following goodness-of-fit initial values: Model χ^2 (7) = 174.32, $p < .001$; RMSEA = .427; CFI = .730; and TLI = .230.

The SEM output showed several paths between variables that would need to be removed. The path from cooperation to curiosity was removed first because it had the highest significance value ($p = .797$). After the arrow was removed, the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (8) = 174.39, $p < .001$; RMSEA = .398; CFI = .732; TLI = .330.

The next path removed was from cooperation to test score because it had the highest significance value ($p = .397$). After the arrow was removed, the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (9) = 175.10, $p < .001$; RMSEA = .375; CFI = .732; TLI = .405.

The next path removed was from recognition to test score because it had the highest significance value ($p = .253$). After the arrow was removed, the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (10) = 176.40, $p < .001$; RMSEA = .356; CFI = .732; TLI = .464.

The next path removed was from challenge to test score because it had the highest significance value ($p = .237$). After the arrow was removed, the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (11) = 177.79, $p < .001$; RMSEA = .340; CFI = .731; TLI = .511.

The next path removed was from competition to test score because it had the highest significance value (p = .184). After the arrow was removed, the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (12) = 179.55, p < .001; RMSEA = .326; CFI = .730; TLI = .550.

At this point, all of the remaining paths were significant between variables. The modification indices table was consulted to determine where an arrow could be added between variables. A path from curiosity to competition was added because the path had the highest modification index (MI) value (52.34), was significant (p < .001), and had a positive expected parameter change (standard EPC = .625). After the arrow was added, the model was tested again and the following goodness-of-fit values were produced: Model χ^2 (11) = 106.12, p < .001; RMSEA = .257; CFI = .847; TLI = .721.

The new model contained a non-significant path from cooperation to competition (p = .241). The path was removed and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (12) = 107.49, p < .001; RMSEA = .246; CFI = .846; TLI = .744.

All of the remaining paths were significant, so the modification indices table was consulted. A path was added from curiosity to recognition (MI = 43.07, p < .001, standard EPC = .472) and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (11) = 55.12, p < .001; RMSEA = .175; CFI = .929; TLI = .871.

Since all of the paths in the structure were significant, the modifications indices table was consulted again. A new path was added from control to recognition (MI = 17.18, p <.001, standard EPC = .284) and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (10) = 33.07, p < .001; RMSEA = .133; CFI = .963; and TLI = .926.

A new non-significant path appeared in the structural table from cooperation to recognition (p = .079) and was removed from the model. The model was tested again and the following goodness-of-fit values were produced: Model χ^2 (11) = 36.12, p < .001; RMSEA = .132; CFI = .960; TLI = .926.

All paths on the model were significant, so the modification indices table was consulted again. The next path was added from recognition to competition (MI = 15.09, p < .001, standard EPC = 1.12) and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (10) = 20.09, p = .028; RMSEA = .088; CFI = .984; TLI = .967.

The inclusion of this new path made the path from competition to recognition not significant (p = .503). It was removed from the model and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (11) = 20.62, p = .038; RMSEA = .082; CFI = .985; TLI = .972.

After the last change, another non-significant path was found in the structural table from curiosity to competition (p = .166). That path was removed and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (12) = 22.52, p = .032; RMSEA = .082; CFI = .983; TLI = .972.

All of the existing paths in the model were significant, so the modification indices table was consulted again. A new path was added from cooperation to control (MI = 8.58, p < .001, standard EPC = .184) and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (11) = 13.65, p = .253; RMSEA = .043; CFI = .996; TLI = .992.

All of the existing paths in the model were significant, so the modifications indices table was consulted again. A new path was added from challenge to competition (MI = 3.97, p = .05,

standard EPC = .145) and the model was tested again. The following goodness-of-fit values were produced: Model χ^2 (10) = 9.35, p = .499; RMSEA < .001; CFI = 1.000; TLI = 1.002.

At this point, all of the paths in the structural table were significant and the modifications indices table did not show any significant additions with positive standard EPC. The goodness-of-fit statistics showed that the model was an excellent fit to the data because the RMSEA was less than .01, the chi-square statistic was not significant (χ^2 (10) = 9.35, p = .499), and the CFI and TLI values were greater than .97. Table 4.9 shows a summary of the alterations to the model, Figure 4.1 shows a diagram of the final model with standardized correlations, and Table 4.10 shows which intrinsically motivating variable is related to each variable on the model.

Table 4.9 - Summary of Model Changes

Alteration	**df**	**Model χ^2**	**Model χ^2 *p***	**RMSEA**	**CFI**	**TLI**
Conceptual Model	7	174.32	< .001	.427	.730	.230
cooperation to curiosity removed	8	174.39	< .001	.398	.732	.330
cooperation to test score removed	9	175.10	< .001	.375	.732	.405
recognition to test score removed	10	175.10	< .001	.356	.732	.464
challenge to test score removed	11	177.79	< .001	.340	.731	.511
competition to test score removed	12	179.55	< .001	.326	.730	.550
curiosity to competition added	11	106.12	< .001	.257	.847	.721
cooperation to competition removed	12	107.49	< .001	.246	.846	.744
curiosity to recognition added	11	55.12	< .001	.175	.929	.871
control to recognition added	10	33.07	< .001	.133	.963	.926
cooperation to recognition removed	11	36.12	< .001	.132	.960	.926
recognition to competition added	10	20.09	.028	.088	.984	.967
competition to recognition removed	11	20.62	.038	.082	.985	.972
curiosity to competition removed	12	22.52	.032	.082	.983	.972
cooperation to control added	11	13.65	.253	.043	.996	.992
challenge to competition added	10	9.35	.499	< .001	1.000	1.002

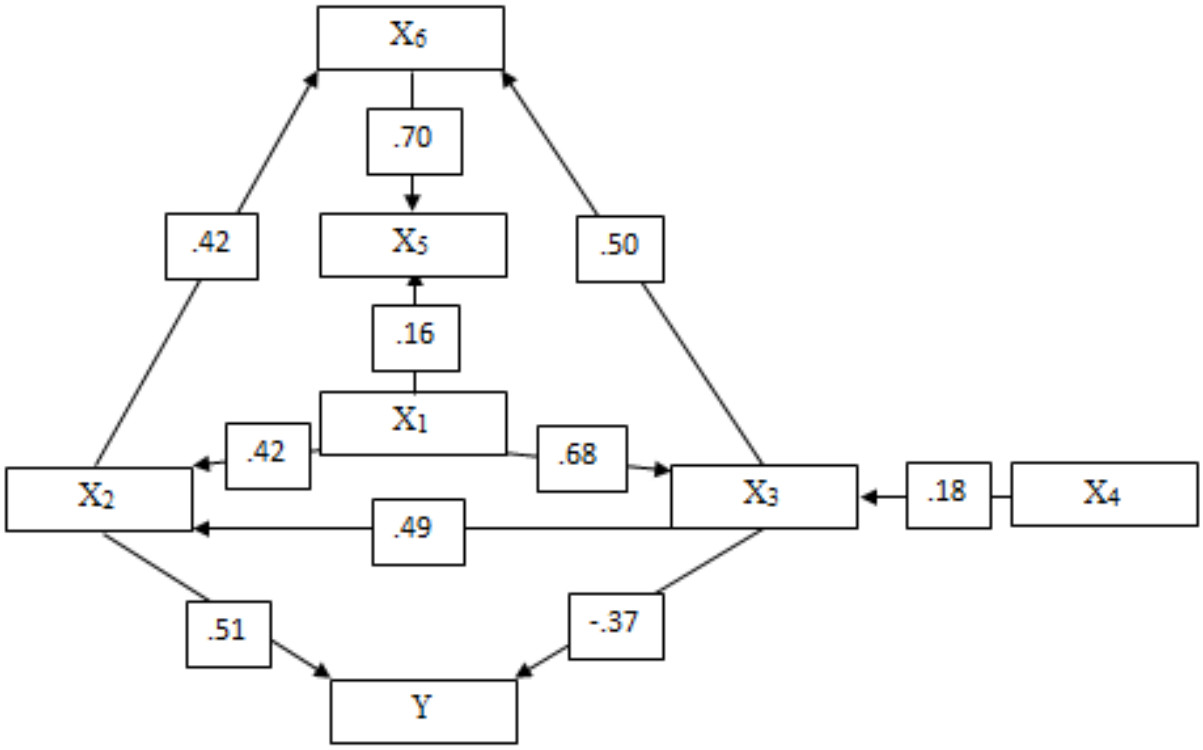

Figure 4.1: Final model with standardized correlations.

Table 4.10 – Variable Descriptions for the Final Model

Variable	Variable Description
Y	Score on a photography skills test
X_1	Challenge
X_2	Curiosity
X_3	Control
X_4	Cooperation
X_5	Competition
X_6	Recognition

Variables with Effects on Test Scores

The final model contained two direct paths and six indirect paths between predictor variables and test scores. The direct effect of curiosity on test scores was .51 ($z = 3.65$, $p < .001$), while the direct effect of control on test scores was -.37 ($z = -2.64$, $p = .008$). Control also had an indirect effect through curiosity on test scores of .25 ($z = 3.24$, $p = .001$).

The variable cooperation had two indirect paths to test scores. One path (cooperation to control to test scores) had an effect size of -.07, while the second path (cooperation to control to curiosity to test scores) had an effect size of .04. The total effect of cooperation on test scores was -.03, which was very low and not significant ($z = -1.11$, $p = .266$).

The variable challenge had three indirect paths to test scores. The first path (challenge to curiosity to test scores) had an effect size of .21, the second path (challenge to control to curiosity to test scores) had an effect size of .17, and the third path (challenge to control to test scores) had an effect size of -.25. The total indirect effect of challenge on test scores was .13 and was found to be significant ($z = 1.99$, $p = .047$).

Gamified Experience Feedback Responses

At the end of the survey, students were given five long answer questions that asked them about specific facets of their game experience. Students were asked to discuss: (a) what they enjoyed about the experience; (b) what they disliked about the experience; (c) what they found easy about the game; (d) what they found difficult about the game; and (e) any other thoughts and feelings about the game that they would like to share. Each response was coded based on common words or phrases that participants used to explain their thoughts and feelings. These codes were combined into themes for analysis of the game experience.

Responses about Enjoyment

The first open-ended question students were asked was: *What did you enjoy about your experience?* Two common themes emerged from student feedback, including thoughts about the competition component and working with a partner.

Several students noted that they enjoyed competing against other teams for a variety of reasons, including the ability to compare skills to other teams and the requirement to develop and hone skills to win later rounds. For example, one student wrote that they enjoyed the competitive aspect of the game because "it motivated me to continue playing the game and trying my hardest." Another student noted that the experience "made the game a lot of fun and made me want to take better photos." The competition component of the game provided students with an external motivator to improve skills and continue trying to do better than their peers each round.

The second common theme among participants was the ability to work with partners during the game. Working with partners allowed these students to collaborate and improve skills together and enjoy the game experience. Some students noted that working with partners allowed them to have more fun with the game, especially when they were "hanging out... and laughing at the horrible pictures we took." Other students explained that working with a partner helped them improve their photography skills because "we could combine our skills together" and "if I didn't have my partner my pictures wouldn't be as good." The ability to work with partners provided some students with a different view of round criteria and helped them to expand their photography skills past what they felt they could do alone.

Responses about Components Participants Disliked

The second open-ended question asked was: *What did you dislike about your experience?* The only common response provided by some students was that they disliked having a partner to

play the game. Several students noted that they felt using partners was not as effective as doing the work themselves and that issues with collaboration and work distribution affected their game experience. One student mentioned that they disliked working with partners because “I think I could have done just as well or maybe better by myself.” Another student noted that they did not like their partner because they “just sat back and didn’t communicate at all.” Student responses suggested that the inequality in time using the camera or time spent arguing over how round goals were completed had a negative impact on their overall experience.

Responses about Components Participants Found Easy

The third open-ended question asked was: *What did you find easy about your experience or have little trouble with?* Two common themes emerged from student responses, including the shot criteria used in the game and thoughts about skills development.

Many students wrote that they found it easy to work with criteria used in the game. Students found that the guidelines they were provided to reference while playing the game helped them to identify and apply photography principles in each round and improve their skills. One student noted that the use of criteria “was easier so you have less of a chance to mess something up and lose.” The established criteria students were provided with each round made the experience easier for them so that they could focus on taking a good photo within defined expectations.

Students also explained that the skills they developed helped make the game easier as they progressed through each round. Several students noted that playing the game for an extended period of time made the criteria easier to understand and allowed them to apply prior experience to new photos. One student mentioned that as the game went on “I understood what I was doing and the game got easier.” Another student wrote that it “eventually was easy to take

great pictures because of realizing expectations and adapting to make some really great shots." Students were provided with feedback that helped to develop and reinforce skills and provided students with the ability to take good photos that reflected their improved capabilities as the game progressed.

Responses about Components Participants Found Difficult

The fourth open-ended question asked was: *What did you find difficult or struggle with?* Responses provided for this question had two common themes: criteria used in the game and composition issues that affected the quality of photos.

Several students provided feedback about the criteria used in the game and why they struggled with it. Students explained that they found some of the shot criteria confusing, including the shot angles and distances. One student wrote that they had difficulty with the criteria because "some of the requests for the photos were confusing and hard to understand for me and my partner so we didn't know what to do." Despite being provided guidance pages that explained shot criteria, some students still had problems with understanding what was expected of them and had difficulty completing round goals.

The second item students struggled with was photo composition. Students provided a variety of reasons why they had difficulty with composition, including sun glare, lighting issues, leveling the camera, framing the subject, and blur. One student had difficulty composing their photos because other groups were "messing around and being in the way of the photo." Students found that taking a good picture required attention to details so that the viewer can focus on the intended subject instead of background components.

Other Feedback

The final question students were asked was: *What other feelings did you have while playing the game? Please use details to explain why you felt that way*. Several students noted that they felt excited and happy to play the game for a variety of reasons. One student was excited because "I really love photography and wanted to show off my skills and creativity." Another student was happy about the game experience because "it was fun and good for me, plus it was challenging and challenges are fun." Students felt excitement because they were coming to class to play a game to learn and would have the opportunity to interact with friends and classmates.

Some students wrote that the experience made them feel angry and frustrated. One student was frustrated with the game experience because "I never got my pictures chosen and I worked hard on all of them" and "my partner did not seem to care about winning or losing." Another student wrote that they were annoyed because "my group wouldn't try very hard or listen to my ideas to make the photo better." The differences between partners and their investment in the game led to frustration and anger since one partner felt that they were not valued as a member of the team, which caused them to have a negative game experience.

Summary

In this section, data analysis and results were explained including the results of multiple regression analyses and a model generated using maximum likelihood SEM. Initial data screening procedures were reviewed as well as the results of a Mann-Whitney U test that was conducted to determine if differences in median responses to survey questions existed between the two student groups used in this study. The results of the multiple regression analyses done on the first three questions of the study were detailed, including the findings of Enter and Forward

methods of variable entry and the multiple regression equations developed with β coefficients. Then, a theoretical SEM model was tested using STATA/SE 14.2 software. The steps taken to develop a final model were listed, including explanations of data used to determine what course of action was taken to improve the model structure. The final model was generated that had excellent goodness-of-fit to the data collected in this study (Model $\chi^2 = 9.35$, $p = .499$; RMSEA < .001; CFI = 1.000; TLI = 1.002), and effects between variables linked directly and indirectly to test scores were explained. Finally, responses provided by participants about their game experiences were detailed to show their thoughts and feelings about the gamified curriculum. The information detailed in this section will be used to drive the discussion in the next chapter.

Chapter 5 – Discussion and Conclusion

Introduction

From the analyses conducted on the test and survey data collected from all participants in this study, three variables were found to have direct and indirect effects on test scores. Curiosity had a direct effect on test scores, control had direct and indirect effects on test scores, and challenge had indirect effects on test scores through control and curiosity. This chapter begins with a review of the findings from the results, including the findings for female students, male students, and all students combined. The next section moves to a discussion of the variables that had significant direct and indirect effects on test scores with evidence from student feedback and observations during the game. Next, variables that had paths to test scores that were not significant and variables with no effect on test scores were discussed. The discussion continues with implications for research and applications to teaching and learning, as well as information about limitations that could impact the generalizability and usefulness of this study. The chapter ends with an explanation of future studies that can be done based on this study to drive research in gamification in education.

Review of the Results

In this study, multiple regression analyses were conducted to determine what combination of the six intrinsically motivating variables predicted test scores. Multiple regression analysis was conducted on survey and test data provided by all students, female students only, and male students only. Along with the multiple regression analyses, an SEM model was developed using maximum likelihood estimation to show how predictor variables directly and indirectly affected test scores. An SEM model was developed using survey and test

data from all students and was found to be an excellent fit for the data (Model $\chi^2 = 9.35$, $p = .499$; RMSEA < .001; CFI = 1.000; TLI = 1.002).

Justifying the Use of Multiple Regression and SEM

Although it would appear redundant to use multiple regression analyses and SEM in this study, each analysis can benefit an instructional designer depending on what they want to know before building a gamified experience. The Enter method multiple regression, Forward method multiple regression, and SEM model each show different information that can support an instructional designer based on their skill and the experience they want to provide for students.

The results of the Enter method multiple regression analysis showed that the only variable that could be used to predict test scores was curiosity. This would indicate that, if an instructional designer wanted to integrate all of the motivating variables into their game design, that they would need to take care to make sure curiosity is strongly embedded in the game and have the other components support the development of curiosity in the game.

Other designers who only want to know which combination of the six variables had an effect on test scores would look to the findings of the Forward method multiple regression analyses. This method found the optimal combination of intrinsically motivating factors that predicted test scores. From these findings, the designer would learn that curiosity positively predicts test scores while control negatively predicts test scores. Designers could use the findings from these analyses to build a gamified experience where they provide opportunities for participants to be curious while minimizing the damaging effects of control.

While the multiple regression analyses provide snapshots that may be all an instructional designer needs, others may want to see how other variables have indirect effects on test scores. The SEM model was necessary to show how all six variables had an effect on test scores as well

as each other. The SEM model expands on the findings of the Enter and Forward method multiple regression analyses to show that other variables, such as challenge, have indirect effects on test scores. The findings from the SEM model can be used to create a complete gamified experience and inform instructional designers which variables have an impact on learning outcomes and which variables affect others.

With each analysis done in this study, the complexity of information grew. Some instructors may want to develop a gamified experience, but do not have as much time as they would like to build it (Cheong et. al, 2014). To ensure that instructors have an opportunity to build a gamified experience, multiple levels of information were provided so that they could focus on what motivational factors affect test scores and tailor their experience to account for those factors.

Findings Based on Gender

Two of the multiple regression analyses done in this study focused on female and male students separately. This was done to determine if there were differences in intrinsic motivations so that single-gender experiences could be tailored to increase intrinsic motivation.

Findings for female students. For female students, the results of this study showed that there were no significant combinations of predictor variables that could predict test scores. Previous studies suggested that females would have significant findings for cooperation since they tend to be more social and are more intrinsically motivated by working with others (Koivisto & Hamari, 2014). Although cooperation had the lowest significance value of all factors noted in the study (p = .297), it was still not a significant predictor of test scores.

Although the findings for female students were not significant, there were not enough data to support study findings. The number of female participants (n = 55) was far below the

acceptable number of participants needed to perform a multiple regression with six predictor variables (n = 111, as calculated using G*Power statistical analysis software). Due to the shortage of participants in this study, these findings would not be helpful in determining what motivating factors predict test scores for female students.

If more data from female participants can be obtained, there is a possibility that cooperation could be a significant predictor of test scores. The inclusion of data from more female participants may reflect the findings from Koivisto and Hamari (2014) and show that cooperation structures are necessary for the gamified experience because of their influence on learning outcomes. There is also a possibility that other factors, such as curiosity, could predict test scores and would need to be embedded in a gamified experience for females.

Findings for male students. Test and survey data collected from male students were able to be used to develop a model that predicted test scores. The Enter method was selected so that all predictor variables were used to predict test scores. Using this method, a significant model was developed [$F(6, 124) = 3.058$, $p = .008$, $R^2_{adj} = .087$], but only curiosity had a significant effect on test scores. A second analysis was done using the Forward method of variable entry to discover what combination of intrinsically motivating factors predicts test scores. A significant model was found [$F(2, 128) = 6.632$, $p = .002$, $R^2_{adj} = .080$] that included the predictor variables curiosity ($p < .001$) and control ($p = .003$).

Previous literature on motivating factors for male students in gamified designs suggested that male students would be more likely to be intrinsically motivated by competition and recognition (Vecchione et al., 2014). Test scores for male students were not predicted by either of these factors, but were predicted by curiosity ($\beta = .512$) and control ($\beta = -.370$). Contrary to

the previous studies, it would appear that male students may not need tangible rewards to be motivated to learn and can be driven by their own curiosity and control over learning.

While the findings for male students are positive, the number of participants (n = 76) was too small to justify whether these variables predict test scores. Similar to the issues found with findings for female students, more data from male participants would be needed to confirm that these variables significantly predict test scores. However, the inclusion of more male participants to achieve a desired sample size would not be expected to change the findings that curiosity and control significantly predict test scores and that the other four variables do not significantly predict test scores.

Findings for All Students Combined

Similar to the findings for male students, a multiple regression model was able to be created that significantly predicted test scores for all students in the study. The first model, which used the Enter method of variable entry, was significant [$F(6, 124) = 3.058$, $p = .008$, $R^2_{adj} = .087$], but curiosity was the only significant predictor of test scores ($p = .001$). A second model was created using the Forward method of variable entry to determine which combination of intrinsically motivating factors could predict test scores, and another significant model was created [$F(2, 128) = 6.632$, $p = .002$, $R^2_{adj} = .080$] with curiosity ($p < .001$) and control ($p = .010$) as the significant predictor variables.

To further explore which variables had a direct and indirect effect on test scores, a ML SEM model was created to test the fit of test and survey data to a proposed model. The modified model was found to have an excellent fit for the data (Model $\chi^2 = 9.35$, $p = .499$; RMSEA < .001; CFI = 1.000; TLI = 1.002) and revealed a third predictor variable that had an indirect effect on test scores. Curiosity and control were discovered to have a direct effect on test scores, while

control had one indirect effect on test scores through curiosity and challenge had three indirect paths through control and curiosity.

Because of the issues with the number of participants for each gender-based group, the discussion for this study will focus on all participants combined. The number of participants for all students combined (n = 131) helps to create a better justification for which variables have direct and indirect effects on test scores.

Discussion

The findings from the SEM model showed that the six intrinsically motivating variables had direct and indirect effects on each other, but not all had an effect on test scores. The six variables fell into one of three categories. The first category, variables with significant effects on test scores, contains variables that had direct and indirect paths to test scores that were found to be statistically significant ($p < .05$). The second category, other variables with paths to test scores, contains variables that had paths to test scores that were not statistically significant ($p > .05$). The third category, variables with no effects on test scores, contains variables that had paths to and from other variables, but did not have paths to test scores. Each of the six intrinsically motivating variables and their effect on the gamified design are discussed in this section.

Variables with Significant Effects on Test Scores

The final SEM model showed that three variables (curiosity, control, and challenge) had a direct and/or indirect effect on test scores. Each of these variables will be explored to explain their effects on student learning and on each other.

Curiosity. Curiosity was the intrinsically motivating factor that was found to have an effect on test scores across all multiple regression and SEM models in this study. This was expected because curiosity is the “most direct intrinsic motivation for learning” (Malone &

Lepper, 1987, p. 235). Curiosity is necessary in gamified environments because the ability to improve skills through questioning and gathering information is needed to improve skills and performance (Stokoe, 2012). For a gamified experience to be effective, participants must have curiosity and an internal drive to want to learn more.

In the photography game, students were required to be curious because they were provided with limited information and had to seek out knowledge of photography principles to improve each round (Morris et al., 2013). Students needed to ask questions about how they could improve their skills, adjust their method of taking pictures based on previous performance, and seek information to fill in gaps in understanding. Through their own innate curiosity, students were able to acquire and develop skills, learn new concepts about photography, and improve their photography knowledge.

Student feedback provided information about how they used curiosity while playing the game. One student noted that they enjoyed the game because “we could be creative and take shots of anyone or anything.” Another student wrote that playing the game “gave me the opportunity to achieve higher standards and learn new things.” With the ability to try new things without the fear of failure, students had the opportunity to determine the best course of action to complete a goal (Kapp, 2012a; Dicheva et al., 2015; McGonigal, 2011). When students are able to try new things and discover working solutions to problems, they are able to raise their standards and achieve higher levels of learning. Ensuring that curiosity is fostered in a gamified experience is necessary to help motivate students to learn new content and develop better skills.

Control. The second intrinsically motivating factor to have an impact on test scores was control. Surprisingly, control had a direct negative impact on student learning even though students had the ability to make choices about how they completed tasks within the rules of the

game (Lee & Hammer, 2011). The experience was designed so that students had the ability to take different photos within the same parameters, but some other constructs appeared to impact the experience they had with the game. One component that appeared to have an effect on control was the inclusion of student-selected partners.

The use of partners had an impact on the control dynamics in the game experience. For example, partners who did not interact well had problems with completing tasks due to the inability to make decisions together about the best course of action. Feedback from students about partner dynamics showed that there were many issues that affected the game experience, including one partner dominating the use of the camera, lack of compromise when deciding what photo to take, and off-task and unhelpful behaviors that impeded progress toward the goal. Control issues appeared to magnify when two people were expected to come to an agreement about how to complete a task, which caused students to have power struggles, disinterest in the game, and impaired learning of photography skills and tools.

If students were able to overcome these control issues and work together toward a common goal, they were able to foster curiosity in learning that created a positive impact on their experience. When students had a common goal and understanding of how to complete it, they were able to share information and understanding of photography skills and grow together. Cooperating with each other created a better relationship between partners that allowed them to be curious and learn (McGonigal, 2011), as opposed to the students who were fighting each other for control. One student who shared control and was able to be curious noted that “collaborating with my partner let me turn in much better photos than if I were to do it alone.” Being able to share ideas, work together, and avoid imbalances in control motivated some students to learn because they could be curious and in control of their learning (Vos et al., 2011).

Challenge. Challenges in the game were needed to test player skills and provide opportunities for participants to develop solutions using trial-and-error (Gumulak & Webber, 2011). These challenges affected curiosity and control in the game experience, which influenced how partners completed goals and learned new material. The effects of challenges expand on what was previously discussed about curiosity and control.

Challenges in games include goals, uncertain outcomes, feedback, and self-esteem (Malone & Lepper, 1987). At the start of each round, students were presented with specific criteria to use to take a photo. Students knew that their photo had the potential to earn points, but their submission was not guaranteed to win points each round. Feedback was provided on pictures each round to show how they met criteria and where improvements could be made for subsequent rounds. Since students were being judged and recognized based on what they could do, it was expected that they would have improved self-esteem in regards to photography skills.

Challenge had a positive indirect effect on test scores when the challenges presented in the game caused students to be curious to learn new photography skills and drove them to improve their abilities. Students who sought out new information from the guidance and from their peers improved their knowledge of photography as they completed objectives. Similar to findings in other studies, it appeared that students who were challenged by game objectives were more engaged and attempting to learn new content (Hamari, Shernoff, Rowe, Coller, & Edwards, 2016). Increasing the difficulty in each round and testing student skills caused them to be curious about their learning and seek opportunities to improve their abilities.

Challenge also had an indirect effect on test scores through control. The indirect effect of challenge on test scores through control had a negative effect, but the branch that went through

control to curiosity had a positive effect. The issues discussed earlier with the direct and indirect effects of control on test scores appear to be related to how participants completed challenges.

In a gamified experience, challenge goals require participants to decide the best course of action to complete them. If participants were able to work together to complete the goal, they could apply knowledge and feedback to come to a solution on what would work best based on prior experience. Having both individuals in the game working together helped to raise knowledge, skills, and self-esteem that inspired them to learn more about photography. However, control issues caused the opposite effect on learning when participants were not able to work together to complete challenges. When participants felt that their input was not being heard or that their partner was not contributing as much as they could, self-esteem was negatively affected, which in turn had a negative effect on learning.

Student comments about their game experience focused highly on the use of feedback related to challenges. Feedback is one of the critical components of a game, since it can lead to curiosity and improving and enhancing skills (Kapp, 2012a; Morris et al., 2013; Saunderson, 2011). With the feedback provided each round, students were able to improve their skills and enjoy playing the game. Students provided a variety of points of view that can be helpful when creating gamified experiences. One student enjoyed receiving feedback on their pictures because they were “given chances to continue improving.” The feedback helped students to improve their skills, which meant that “rounds got easier based on prior experience.” However, one student noted that feedback was “not given to winners when they need it.” It is important to remember that some students may be looking to improve the fine details of their work and still need feedback regardless of the photo quality. Providing feedback for photos each round gave students

new information to increase their curiosity about learning photography skills, which in turn may have improved their learning outcomes.

Other Variables with Paths to Test Scores

The SEM model showed that the intrinsically motivating variable cooperation had indirect paths to test scores through curiosity and control. However, each indirect path and the overall effect on test scores was not significant ($p > .05$). Although the effect of cooperation on test scores was not significant, it was a major theme in student feedback provided in their survey responses and was often paired with thoughts related to curiosity and control.

During game development, a decision was made to have students work in pairs so that they could use each other to generate ideas and take a picture that both agreed was high quality. It was expected that students would work together to complete game goals, which would lead to enjoyment in playing the game (Koivisto & Hamari, 2014). The use of partners appeared to have the desired effect for some students, but not others. One student enjoyed having a partner to work with because "taking pictures and working with another person allowed us to combine our skills together." However, another student had a bad game experience, noting that they disliked working with their partner because "if we didn't agree on a photo, we would argue. Then the other person would demand that they should take the photo."

Cooperation between partners was highly affected by the level of control each partner had in the game. If there was an imbalance in control, cooperation appeared to break down and one or both partners would get frustrated. When both partners were equal contributors in the game, they were able to come to decisions together and share responsibility for completing tasks. For cooperation to work, members of a team need to be willing to work with each other and compromise to complete goals. To help students to avoid control issues, it is important to design

the game with rules and guidelines that require students to have responsibility in making decisions and learning outcomes.

Variables with No Effect on Test Scores

The final SEM model showed that two variables, competition and recognition, had no direct or indirect effects on test scores, but did have paths between them and other variables. While they did not have a significant effect on test scores, they still had an impact on the overall gamified experience and how students viewed the game.

Competition. Competition was embedded in the game to intrinsically motivate students using extrinsic motivators. At the end of each round, points were given to students who were able to incorporate all criteria into their photo. The goal of using points was to help students to be intrinsically motivated to work harder each round and meet or exceed the skills of their peers. The use of a scoring mechanism appeared to motivate students since they did not want to lose to their peers.

Competition was a difficult factor to account for because of all the pitfalls that could come with having students compete against each other. For example, some students were more focused on competing with other teams instead of using their partner as a collaborative resource for taking pictures (Glover, 2013). This became evident throughout the game as some students became frustrated at how others acted during gameplay and post-round analysis. Some students noted in their feedback that other teams showed “poor sportsmanship to other teams” and “gloated and bragged at the end of the game”. The negativity produced by the competition aspect of the game turned some students away from enjoying the game and may have negatively impacted the learning benefits that the game was supposed to bring (Wang & Sun, 2011).

Although competition alienated some students, others were very motivated by the competitive aspect. Viewing their standings against their peers caused several students to compete harder since they had an objective to win and a drive to show that they were more capable than their peers (Banfield & Wilkerson, 2014; Lei, 2010). The competitiveness of the game can create the motivation some students need to do better, but can be costly when that motivation comes at the expense of others.

Recognition. Students were provided recognition throughout the game to help keep them motivated to continue learning new photography skills. First, student work was recognized by showing the photos taken by every pair each round. Recognizing each picture while displaying it through a projector provided students with the opportunity to shine and show others their talent and skills (Montola et al., 2009). Showing their work to the class also provided the instructor opportunities to provide feedback on their work and explain how students demonstrated good photo composition, which could improve their self-esteem. The second recognition mechanism was the distribution of points for teams that met criteria for the round.

When the game was designed, it did not include a larger prize that would extrinsically motivate students to play the game. The lack of a larger prize was an intentional design choice because extrinsic motivators can have a negative effect on intrinsic motivation (Ryan & Deci, 2000). However, the lack of a larger prize may have caused some students to not be as invested in the game since they thought that the points system was not motivating enough to pursue (Attali & Arieli-Attali, 2015). Adding a recognition tool that improves intrinsic motivation without devaluing the experience may cause that variable to have an effect on test scores.

Implications

The findings of this study can be used to drive future research and help teachers and instructional designers to develop gamified curriculum. This section includes suggestions about how the results of this study apply to current and future research. It also includes suggestions for applications to teaching and learning so that teachers and instructional designers can apply these findings to their own gamified design.

Research Implications

One of the main purposes of this study was to explore the effects of gamification at the secondary education level. Previous studies have noted that there are very few studies that examine the effects of gamification on learning at the secondary education level (de Sousa Borges et al., 2014; Dicheva et al., 2015). This study provides information about which intrinsically motivating factors predict learning outcomes and have an effect on test scores for middle school students.

This study focused on the six intrinsically motivating variables and their ability to predict test scores. This creates several avenues for research to further explore gamification and its effects on learning. One variable in particular, cooperation, needs to be explored further to discover how it can fit better in a gamified design. In this study, cooperation was found to be a fringe factor in the SEM model that did not influence test scores. One explanation may be that students were required to work with partners during the game, which is not always a requirement when playing games not designed for educational purposes. Studies can be done that focus on the role of cooperation in gamified learning environments and whether using individuals, pairs, or larger groups have an impact in learning outcomes.

While this study focused on middle school students, the findings can be used to inform gamified design for primary school students, high school students, and higher education. This study was structured so that students were given enough guidance to complete round requirements while still maintaining a sense of curiosity about their learning. The structure of this study can be altered to fit the needs of students at lower and higher grade levels. For example, students in a primary school setting may need more structure and smaller goals to achieve to remain interested in the game. Conversely, students in higher education can be given more freedom and less structure so that they are required to be curious and collect topic information on their own. Research can be done on the balance of freedom and structure to determine what the best combination is for each level of learner.

The findings of this study can also inform experimental research on gamified learning. As was stated earlier, this study explored the predictive nature of the six motivational factors on test scores. Future research could explore the effect of this and other gamified lessons on learning outcomes compared to traditional teaching methods to determine if they lead to improved learning outcomes.

Applied Implications

Based on the findings from the multiple regression analyses and the SEM model, several suggestions can be made for gamified design applications that can benefit teaching and learning. The data collected in this study showed that each predictor variable had an impact on the game experience, but only a few influenced test scores. Gamified lesson designers will want to consider the following items when creating their gamified experience.

Study variables and game design. Curiosity is the most important variable that needs to be accounted for when developing a gamified experience. When students seek out information or

discover new solutions to a problem, they are in charge of their learning and become responsible for finding out as much as possible about it. For students to be curious, constructs in the game need to be embedded that require students to seek out answers and improve their knowledge of the topics learned in the game (Gumulak & Webber, 2011). If students are not required to be curious in a gamified experience, they may become disinterested in learning and miss out on opportunities to enhance skills and knowledge. Gamified lesson designers need to ensure that curiosity is a focal point of their design since several other motivational factors use curiosity as a pathway to influence learning outcomes.

A second factor that needs to be accounted for in gamified design is control. As noted in this study, control issues had a negative effect on test scores because some pairs had imbalances in responsibilities and input each round. To minimize the negative effects of control, the gamified design needs to include rules and constructs that require partners to have equal representation in the game. One item that will need to be changed for this study is that the rules and guidance will need to be updated to require partners to switch responsibilities every round so that each partner has equal access to the camera and decisions about how to complete goals. This may help students to learn to cooperate better and come to a shared decision so that both partners are responsible for their submission each round.

Curiosity and control had a direct effect on test scores in this game, but they were not the only factors that had an effect on test scores. With these two intrinsically motivating factors accounted for, the designer will need to focus on making sure the challenge aspects of the game are clearly defined. Since challenge has an indirect effect on test scores, instructional designers will need to make sure that there are goals, uncertain outcomes, and feedback to help students

move forward in the game. Providing students with clear information can help students to improve their self-esteem as they succeed in performing tasks.

Finally, instructional designers will need to complete the game experience by developing cooperation, competition, and recognition structures that help motivate students to learn new content. Providing opportunities for students to work together and against each other can motivate them to work harder to improve their skills. Recognizing successes with an extrinsic motivator that matches the level of effort used can further motivate students to learn new material while playing the game (Wang & Sun, 2011).

Suggestions for classroom application. The gamified photography curriculum used in this study provided students with the opportunity to be intrinsically motivated to learn and engaged while playing the game. Games have the ability to increase engagement because humans are naturally interested in playing games and can be motivated to learn when using them (Apostol et al., 2013; Barata et al., 2015; Bíró, 2013; Measles & Abu-Dawood, 2015). These suggestions can help to create an engaging gamified experience for students.

When developing a gamified unit, it is important to remember that students are expected to have fun while learning. Students should be provided with opportunities to discover knowledge on their own and interact with their peers so that they create a shared fund of knowledge (Barata et al., 2015). This means that participants need to be able to move around, share ideas, and come to an understanding of the content through interactions with the teacher and peers. The teacher is not a sole source of knowledge in a gamified setting, but is a facilitator of learning and helps their students to become more curious about the content they are learning.

One of the items that may have negatively impacted this study was the cooperation component of this gamified design. As was noted in the study, cooperation did not have a

significant effect on test scores even though students were required to cooperate with partners and other students in the class. There are several suggestions that can improve cooperation between students. One idea that could improve cooperation would be to have students work alone to take photos, but have to work with others to take photos that require more than one person. This would allow students to turn in photos that they deem to be high quality and have the opportunity to gather information from other players that could benefit their learning. However, this approach would require one-to-one technology access to devices from a single company, such as Apple, so that each student has a device and can share photos with the teacher easily.

A final item to consider when applying gamified design is that it takes time to develop an engaging experience (Cheong et al., 2014). Careful planning and idea development need to be done to create an engaging experience. If every component of a gamified design is not thought through or embedded properly, students can become disengaged and disinterested in learning (Kapp, 2012b). The development cycle for this game included a significant amount of work, including decisions about what game to derive rules and structure from and what learning content would be a good fit for the game. Although it is time consuming, the rewards for building a game that motivates students to learn makes developing gamified lessons worthwhile.

Tips for Development and Implementation

Throughout the development of this game, there were several items that could be pointed to that made the game successful. These components helped to improve the overall design of the game and appeared to provide students with an engaging experience so that they could learn new material. The following tips can be used by other instructors to develop a gamified experience.

The first item that instructors want to consider is using existing rule sets and structures from games that students are familiar with to develop their gamified experience (Horner, 2016). Familiarity with the game structures can lead to less time explaining how the game is played, less confusion about what is allowed during gameplay, and more motivation to play. The use of a simplified rule set can help students to quickly acquire information necessary and begin play in a shorter time frame.

Although the rules are supposed to be established at the beginning of the game, there are times that participants require new rules to be implemented as the game is played. For example, participants in this game had issues with one person monopolizing the use of the camera, which impacted the development of photography skills for other participants. To remedy this for future games, a new rule would need to be established that defines how long each person is allowed to use the camera so that there is equal access and investment in the experience. Designers should not be afraid to modify how the game is played during gameplay to make an engaging experience for all participants.

When developing the game, designers need to put themselves into the role of the participant so that all components of the experience are in place. The designer should constantly be thinking structures that can make the game accessible to all ability levels. For this game, participants had varied levels of photography skills that could impact how well they did each round. Defining what technology students could use and determining requirements for each photo created a level playing field where any pair of students could earn points each round and be motivated to continue playing the game. Developers need to be mindful of who is playing the game and make the experience enjoyable at every skill level.

When developing a gamified experience, instructors need to avoid adding game design elements that do not create a true game experience. For example, it would be simple to give students a list of photo requirements and give them a point for every completed picture. However, this approach is no different from completing a worksheet and may not have any effect on their skill development. Giving students points because they turned in a picture may not necessarily require them to improve skills or be motivated to learn. Providing them with challenges to complete and selectively awarding points to those that earned them requires students to become engaged in the learning experience and make an attempt to improve their skills.

Instructors need to seek out support from colleagues and outside resources when developing a gamified experience so that they can have success when implementing the game. First, a designer should work with a team to create the gamified experience so that multiple viewpoints are considered and problems can be addressed before implementation. It is possible to develop gamified experiences alone, but critical components can be overlooked that may not emerge until the game is played. The designer should seek out others to work with to create the gamified experience so that these oversights can be addressed and a complete gamified experience can be implemented. Second, the designer may need to seek out resources to play the game. A class set of iPads were used for this game so that all students had the same technology and no technical advantages could be gained from other devices. Having all of the students use the same brand of iPad also reduced problems with transferring photos and technology support that may have negatively impacted game flow. The designer may need to seek school funds or grant opportunities to obtain materials for the gamified unit so that students have a good experience.

Finally, designers need to think of the needs of their classroom before developing a gamified experience. The findings from this study can inform other instructors that they need to include structures that foster curiosity and minimize control issues. The social studies curriculum appears to be a good area to apply gamified design because each topic contains a large amount of material that can be integrated into the game experience. For example, the content of World War II could be gamified so that students act as one of the six major countries in the war and attempt to gain as much territory as possible. For students to advance troops and conquer countries, they will need to develop battle strategies based on information found in books and on the internet about war tactics. Students will also need to discover information about the countries they are invading so that they can understand more about the battles fought there. While this may lead to some revisionist history since some students may take over areas that their country did not occupy in the war, it can motivate students to find new information and use it to their advantage to win the game.

Gamified experiences require a lot of forethought and planning before development can begin and require designers to consider many items before they can implement them. While developing a gamified experience requires a lot of time and effort to complete, it can create an engaging experience where students are motivated to learn new material and gain knowledge that they might not have been interested in learning when traditional teaching methods are used. Instructors who are interested in gamifying curriculum need to be aware of the struggles that come with designing an engaging experience, but will enjoy the motivation students have to learn when the experience is shared with them.

Conclusion

Based on the findings from this study, two of the six intrinsically motivating factors detailed by Malone and Lepper (1987) as necessary to create a gamified experience had a direct effect on test scores in a photography unit. These factors, curiosity and control, need to be thoughtfully integrated and moderated in gamified learning experiences to ensure that students are motivated to learn new material and can apply that knowledge to content assessments. In summary, two main conclusions can be drawn.

First, for a gamified learning experience to be effective, structures need to be meaningfully integrated into the game experience that cause students to be curious about their learning and want to learn more about the topic at hand. Therefore, gamified instructional designers need to develop structures within the game that increase student curiosity to learn new material. When designing a gamified experience, instructional designers need to focus the game so that students seek out new information that expands their content knowledge within the rules of play. This can be accomplished by creating structures that cause students to find information based on clues and incomplete information or by providing on-the-spot information that students need to think about before applying it to the game. If the gamified experience includes embedded structures that require students to take control of their learning and find an intrinsic desire to learn new information on their own, students may learn to be curious, independent, self-motivated learners who enjoy learning new material.

Second, gamified instructional designers need to embed rules and structure in the game that minimize the effects of control regarding team dynamics and devices and maximize the effect of being in control of how new information is acquired. There are many issues with control that can negatively impact the game experience and content learning. Setting up rules

that determine how frequently a student can use a device or who acts as the team leader each round may help students to focus on completing goals for a round instead of struggling for power over team functions. These structures can help students to find their voice and become a valued member of a team that works productively toward completing a task. Applying more rules to guide the game experience and create equal partners in a team dynamic can move the focus away from controlling others on a team to controlling the knowledge to be gained and can lead to shared curiosity in learning.

Finally, gamified instructional designers need to develop challenge structures that enhance the game experience and lead to curiosity and shared control. Challenges need to be created through the development of rules and goals that govern what students are allowed to do during game play. Rule sets should be derived from games students are familiar with so that less time is used explaining how the game is played. The use of existing game rule structures can allow for more time playing the game, which can improve engagement and motivation to learn. Game goals must include a degree of difficulty that requires students to seek out information to improve their knowledge and skills. The inclusion of structures that force students to find information can lead to improved curiosity and a deeper understanding of content material. Finally, structures need to be developed that cause uncertain outcomes so that students do not know if they have completed a goal until the end. These structures need to be included so that students are motivated to keep working until they have fully completed a goal. The proper application of challenge can influence learning outcomes due to the improvement of curiosity to learn and the shared responsibility to discover new information that comes when control is shared between game participants.

Limitations

While there were many findings in the study that can help to improve teaching and learning and drive research in gamification, several limitations affect the study findings. These limitations may have an effect on the generalizability and usefulness of the findings.

The first limitation to this study was that the study researcher was also the game developer and the evaluator for learning outcomes. This may have had an impact on several items in the game that involved students. For example, students may have answered questions on the Intrinsic Motivations Survey differently than they would have if the game had been administered by another teacher. The researcher may have had an unintentional influence on survey responses since some students may have wanted to avoid consequences for responses that represented their true feelings. The influence on survey responses may have skewed data toward more positive findings that may not be similar to other classes who implement the gamified curriculum.

The second limitation in this study was that the study was done over two semesters. One group of students in a spring semester of the class and one group from a fall semester were used to reach the required minimum number of participants to generate the multiple regression and SEM models. Since the study was done over two semesters, the learning experience may have been different for the two groups. Although every effort was made to keep the experience the same between the two semester groups, there may have been variations in how the game was administered that could benefit one group over the other. This may have caused differences in test scores or in attitudes about the game that students expressed on the Intrinsic Motivations Survey.

A third limitation to the study was that the number of participants for each gender were too small to develop multiple regression models that predicted test scores. The information that could be gathered from findings for each gender is important because there may be differences in factors that motivate male and female students to learn. For example, previous literature suggested that female students are motivated by cooperation components of games (Koivisto & Hamari, 2014), and more participants may have reinforced these findings. The inclusion of more male participants would also reinforce the findings that curiosity and control have an effect on learning outcomes. The total number of students used in the study was enough to develop a model for all students, but the number of male and female students was not sufficient enough to generate models that are generalizable or useful in other learning environments.

A fourth limitation for this study was that the game was built for a photography unit. The gamified design worked for the classes that the game was implemented in because there was more freedom in regards to the amount of time that could be spent on the game. Other core content classes may not be able to accommodate a lengthy time period to implement a gamified unit, especially if content needs to be covered for high-stakes testing. For example, math classes may have a required curriculum that they must cover before end-of-course exams or other state tests, which may make it difficult to add gamification to their curriculum. Issues with time constraints in the classroom and time to prepare and deliver the gamified curriculum may make it inaccessible to some teachers. While some design structures in this study may support the development of gamified design in core content areas, there may need to be significant changes to the design process to support student learning in smaller time frames and to allow for other content to be covered before the end of the course.

A fifth limitation for this study was that the study did not explore how student experiences in the gamified curriculum differed based on culture, race, and ethnicity. Some students may have had positive and negative experiences in the game due to their background and how they perceived the game experience. This study did not look to gain insight on how student experiences differed from peers of different ethnicities, which could be used to inform gamified design for classrooms based on demographic populations. While the design of this study may help others to develop a generalized curriculum, more studies will need to be done with diverse groups of learners to identify differences in experiences students have when taking part in a gamified curriculum.

Future Studies

The implications and limitations of this study provide new opportunities to improve on this gamified experience and explore new ideas for gamification in core content areas. These ideas can provide more information that can be used to develop other successful gamified experiences. The studies suggested in this section fall into two categories: exploring the current game design and new gamified design possibilities.

Exploring the Current Game Design

The game and the instruments used to evaluate student learning were developed for this study and can be reevaluated using the ADDIE model to improve them for future use. Along with these modifications, other studies can be done to determine the effect of gamification on learning compared to other traditional teaching methods. Four studies can be done to improve the current game design and may be useful in evaluating other gamified designs.

The Intrinsic Motivations Survey developed for this game was used to measure student attitudes toward the six intrinsically motivating variables embedded in the game design. This

measure is in its infancy and needs more development and application to ensure that all of the structures are measuring what they intend to. The survey also needs development to make it more generalizable to other settings and help others to identify strengths and weaknesses in their gamified design. The gamified photography curriculum will need to be implemented several more times so that the survey can be administered to collect more data and improve its reliability and validity.

While the Intrinsic Motivations Survey is tested in games during future implementations, more data can be collected from female and male students to be included with the groups from this study. Collecting more data can help to create more reliable multiple regression models that help to determine if there are differences in motivating factors that affect test scores. These findings can be used in other studies to design gamified instruction that motivates each gender to learn new content.

Another study can be done to explore how the use of individuals as opposed to partners affect the game experience and, in turn, learning outcomes. Several students noted that the use of partners caused them to have negative experiences during the game. A study can be conducted to compare the scores of classes that work individually to the scores of classes that work in self-selected pairs. These findings can be used to discover how the variable cooperation is affected based on group type and be applied to other gamified experiences.

A third study can be done to explore how the gamified experience differs for students of different races and ethnicities. The effect of race and ethnicity on learning motivation was not explored in this study, but the information that could be gained from exploring which motivational factors affect learning outcomes for each ethnicity could help to inform gamified design for diverse learners. Studies would need to be conducted across several schools so that

participants from different races and ethnicities could be surveyed and a better picture of learner motivations could be obtained.

Finally, a study will need to be conducted to determine the effect the gamified photography curriculum has on learning compared to traditional photography teaching methods. The current study found that some intrinsically motivating factors have an effect on test scores, but a future study will need to be done to determine if the gamified design has an effect on test performance compared to other methods.

New Gamified Design Possibilities

The survey and test data collected in this study was used to generate a model to show how test scores are influenced by the six motivating factors. The model also showed that the motivating factors have an effect on each other as well, which would suggest that a gamified experience needs to include all of them to make a game that motivates students to learn. The model needs to be fully analyzed to explore the connections between variables and test scores so that others can be informed about variable connections and their effect on gamified lesson design. More studies in gamification need to be conducted to confirm the findings of this study and work toward developing a generalized model that fits for any gamified lesson design.

Along with these studies, other gamified units could be developed and tested in content specific areas. For example, a gamified unit could be developed that teaches science principles or engages learners in math. Using the findings of this study to inform the design and development of other gamified designs could lead to improved learning and skills development in required secondary education courses. The studies done in core content classes can help to inform other gamified lesson designers about best practices that help the gamified lesson fit into existing

course curriculum and take into account the length of game play and required structures that support learning.

Summary

In this chapter, the findings of the study were explained in detail. Each of the six intrinsically motivating variables used in the game was explored using the results of the multiple regression analyses, SEM models, and feedback provided by students. This information was used to explain the significance of each variable on test scores and other variables in the gamified design. Based on these findings, recommendations were given for future research and to help lesson designers to develop a successful gamified learning experience that motivates students to learn. Advice was also provided so that other instructors could develop a gamified experience for their classrooms. Finally, limitations to this study were addressed and several new studies were explained that can improve on this gamified design and inform design in other content areas.

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Appendix A – CLICK Game Rules

Photography game – “CLICK”

Purpose: To teach students the fundamentals of shot types and rule of thirds before students work on an instructional photography project.

Objective: Earn all of the letters of C-L-I-C-K to win. Letters are earned by taking the best photo and winning the round.

Rules/Game Flow –

1. All participants are only allowed to take pictures using the iPad. No other devices can be used during the game.
2. Students will form their own pairs for the duration of the game.
3. The teacher will begin the game by choosing a shot type and a scenario the teams must use in their photo.
4. Students will have 5-7 minutes to submit their photo to the teacher’s iPad using the AirDrop function.
5. After 5-7 minutes, the teacher will look through the pictures and select the best photo from the class. The teacher will go through and explain what qualities were good and bad in each photo so that students are aware of their errors for future rounds. This individual will be awarded with one letter toward the word CLICK.
6. In later rounds, the winner of that round will be in charge of calling the next shot. They can choose one shot type and one defining criteria that all others must follow. The winner is not exempt from this round and can earn another point if they win it.
    a. Teacher can designate a tie if two or more people put in an equally good shot. Teacher will then designate who chooses the next shot from the tied individuals.

   b. If shot quality for all participants does not meet criteria, there is the option for no winner and the teacher will choose the next criteria.

7. The game ends when one person has completed the work “CLICK”. There should be enough rounds completed that all shot types and distances have been used at least once.

Appendix B – Intrinsic Motivations Survey

Survey on Motivations to Learn Through Gameplay

This survey will measure how playing the game motivated you to learn. There are no right or wrong answers, and your honesty is appreciated. Please select only one answer option for each question.

For the following set of questions, please circle the option that best reflects your opinion.

1. I enjoyed playing this game.

Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree

2. I thought that playing the game was a good way to learn content

Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree

3. I feel that playing a game to learn new content will help me remember it longer.

Very Strongly Disagree	Strongly Disagree	Disagree	Agree	Strongly Agree	Very Strongly Agree

Challenge Questions

The following questions will relate to goals, feedback, and uncertain outcomes while playing the game. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
The goals of the game were clear to me.						
The challenge provided by the game motivated me to keep playing						
The feedback to my photos motivated me to improve in the next round						
I was given useful feedback on my photos						
The game was easy to learn to play						
I had a choice in how I completed the picture for each round						

Curiosity Questions

The following questions will relate to how the game made you curious about learning. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
The game motivated me to learn photography skills						
I was interested in learning about photography because I played the game						
My interest in the game motivated me to keep improving my skills each round						
I was provided with enough information to take each photo						
I found new ways to take pictures that I used in later rounds						

I was motivated to learn to take photos because I got enough information about photographs						

Control Questions

The following questions will ask you how your choices affected your motivation during the game. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
I felt that I had many choices about what picture to take each round						
I felt like I was doing what I wanted to do each round						
Being able to make choices about my photo motivated me to improve my photo-taking skills						
I felt in charge of my learning while playing the game						
I felt motivated to play the game because there was shot criteria for each round						
Being able to make choices about my photo motivated me to keep playing						

Cooperation Questions

The following questions will ask you about how working with team members affected your motivation to play the game. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
Working with a partner helped me improve my photography skills						
I felt that my partner and I had equal input on each picture we took						
I enjoyed working with a partner during the game						
Working with a partner helped me to understand the parts of the photo we were taking						
I felt that my partner showed effort and teamwork while playing the game						
I felt that working with teammates made learning photography skills more interesting						

Competition Questions

The following questions will ask you about how competing against others affected your motivation to play the game. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
Working against other teams helped me to improve my photography skills						
I felt that competing against other teams made the game more interesting						

I enjoyed competing against other teams						
Working against other teams motivated me to take better pictures						
I think the letters given after each round were given to the team that deserved them						
I felt that competing against other teams motivated me to take better photos each round						

Recognition Questions

The following questions will ask you about how others seeing your work affected your motivation to play the game. Please put an X in the column of your answer. Your options are Very Strongly Disagree (VSD), Strongly Disagree (SD), Disagree (D), Agree (A), Strongly Agree (SA), and Very Strongly Agree (VSA).

	VSD	SD	D	A	SA	VSA
I felt motivated to turn in my best work						
I felt a sense of pride in my work because it was seen by others						
I felt that the teacher recognized the effort I put into my work during the game						
Seeing pictures taken by others motivated me to improve my photography skills						
I felt that the rewards earned after each round motivated me to keep playing						
I felt that the winning picture in each round was fairly selected						

Personal Information Questions

For each question below, please circle the response that describes you.

What is your gender?	Female	Male		
What is your Ethnicity?	African American	American Indian/ Alaskan	Asian	Hispanic
	Pacific Islander	White	Two or More Ethnicities	
What level of skills did you have in photography before playing the game	No Photography Skills	Very Low Skill	Low skill	
	Moderate Skill	High Skill	Very High Skill	

Do you have any other things I should know that I did not ask you in this survey? You may use the back of this paper if you need extra space.

_____

_____

Please reflect on your experience of learning photography skills while playing the game. You may attach another piece of paper if needed.

1. What did you enjoy about your experience?

2. What did you dislike about your experience?

3. What did you find easy about your experience or have little trouble with?

(continued on back!)

4. What did you find difficult or struggle with?

5. What other feelings did you have while playing the game? Please use details to explain why you felt that way.

Appendix C – Photography Unit Test

Photography Skills Test **Name: _____**

For this test, you will recall the photography skills you learned during the photography game "CLICK". Follow the instructions for each section of the test. All answers need to be written on the test.

Section 1 - Matching

Write the letter of the definition from the right column on the blank next to the term on the left column.

___ 1. Extreme Wide Shot

___ 2. Very Wide Shot

___ 3. Wide Shot

___ 4. Mid Shot

___ 5. Medium Close-up Shot

___ 6. Close-up Shot

___ 7. Extreme Close-up Shot

___ 8. Group Shot

___ 9. Over-the-shoulder Shot

___ 10. Selfie Shot

a. A shot taken from a high angle
b. The full subject can be seen in the frame
c. The photographer focuses on a feature or part of the subject
d. The photographer shows extreme detail of a specific part of the subject.
e. The shot is taken very far away, and sometimes the subject is not visible.
f. Halfway between a close-up and a mid shot
g. The subject is barely visible, but is still the focus within a larger environment
h. Uses two subjects and gives the appearance that you are listening in to a conversation
i. Used when two or more subjects are in a picture
j. Approximately half of the subject can be seen.

Section 2 - Multiple Choice –

Select the option that best answers the question. Write the answer of your response on the blank next to the question number.

___ 11. A selfie is an example of a:
a. High angle shot
b. Low angle shot
c. Eye-level shot
d. Bug's eye view shot

____ 12. This shot is most commonly used when pictures are taken:
a. High angle
b. Low angle
c. Eye-level
d. Bird's eye view

____ 13. Movies shown in theaters use what kind of image orientation?
a. Portrait
b. Landscape
c. Eye-level
d. Medium angle

____ 14. When framing a shot, it is important to divide the image using:
a. The rule of shortest distance
b. The rule of halves
c. The rule of simplicity
d. The rule of thirds

____ 15. You are going to take a picture of a person's eye. Which shot type is most appropriate?
a. Extreme Wide Shot
b. Medium Close-up Shot
c. Extreme Close-up Shot
d. Close-up Shot

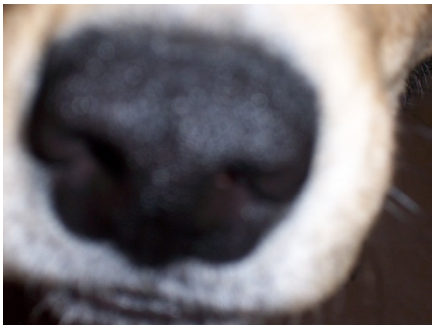
____ 16. Using two or more subjects in an image where all faces are visible is also known as a:
a. group shot
b. over-the-shoulder shot
c. very wide shot
d. selfie shot

____ 17. Which of the following pairs of objects and backgrounds would give the best contrast?
a. A white object against a white background
b. A white object against a black background
c. A yellow object against an orange background
d. A blue object against a darker blue background

____ 18. Which of the following would describe an image from a bug's eye view?
a. Taking a picture of a city from an airplane
b. Taking a picture of a tall building from the very bottom
c. Taking a family photo at a wedding
d. Taking a picture of a field from the top of a building

Section 3 - Fill in the Blank

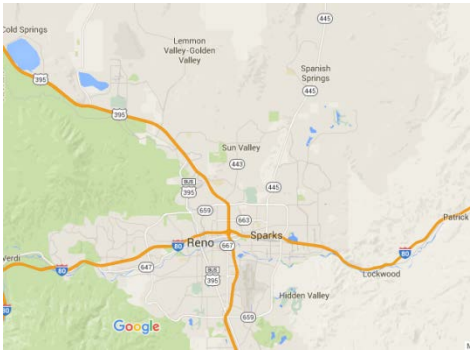
For the following questions, fill in the blank for what each question is asking.



19. Shot Type - _____

20. Shot Angle - _____

21. Shot Type - _____



22. Shot Angle - _____

23. Shot Type - _____

24. Shot Type - _____

Section 4 - Long Answer/Constructed Response Questions

In this section, answer the question as completely as possible.

25. Does this picture follow the rule of thirds? Explain why or why not. (6 points)

26. You are going to take a picture of the night sky in Reno. Complete the following tasks for this question:

a. In the box below, draw a rough sketch of the picture that you would attempt to take (6 points).

b. Below the box, describe the composition of your image, including angle, shot type, subject(s), rule of thirds, and any other important parts of your picture that I should know about (10 points).

b. _____

Test Answer Key –

Matching -
1. e
2. g
3. b
4. j
5. f
6. c
7. d
8. i
9. h
10. a

Multiple Choice -
11. a
12. c
13. b
14. d
15. c
16. a
17. b
18. b

Fill in the Blank -
19. Extreme close-up/close-up
20. high angle
21. wide shot
22. Bird's eye view
23. extreme wide shot
24. mid shot

Long Answer
25. No (2 point). The subject of the photo takes up only a quarter of the picture. Based on rule of thirds, it is not taking up the right 2/3 of the photo or the top 2/3 of the photo evenly. (Content of answer may vary, but answers must come to this conclusion to receive final 4 points)

26. Scoring guide –
a. Sketch – follows rule of thirds, image is relevant to what is being asked in the question (6 points)
b. Long answer – student describes angle, shot type, intended subject (if one exists), describes qualities of shot, explains how it fits rule of thirds, and extra information to demonstrate knowledge of photography skills learned during the game (10 points)

Appendix D – Photography Skills Guidance

Photography Basic Information

Subject – the object that the photographer focuses on in an image. This can be anything!

Composition – all of the components that make a picture. These include:

- Subjects
- Objects around the subject (background)
- Shadows and lighting
- Shot type and angle
- Framing, lines, and edges

Important things to consider when taking pictures:

1. Simplify the Background – too much stuff in the background can distract the viewer.
2. Keep it simple – take a picture with fewer objects so that the subject is the main focus
3. Watch contrasting colors – Using two different colors, like a black object against a white background, will draw attention to the object that looks different from the rest of the image.
4. Make sure the whole object is in the image. Avoid cutting off important pieces (arms, legs, wheels, etc.)

Shot Types –

Extreme Wide Shot (EWS) – A shot taken very far away from the subject. Sometimes the shot is so far away the subject is often not visible.

Very Wide Shot (VWS) – The subject is barely visible, but the emphasis is still on the subject within a larger environment.

Wide Shot (WS) – The full subject (or almost the entire subject) can be seen in the frame.

Mid Shot (MS) – Approximately half of the subject can be seen. For people, this shot would be from the waist up.
Medium Close-Up Shot (MCU) – This is half-way between a close-up and a mid shot.

Close-Up Shot (CU) – The photographer focuses on a feature or part of the subject. This shot usually fills up the whole frame.

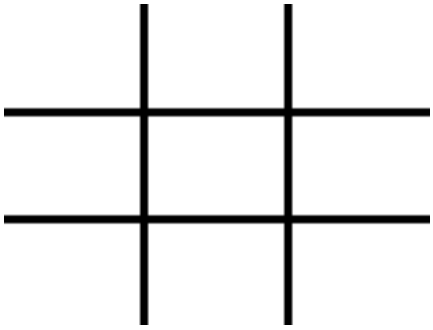
Extreme Close-Up Shot (ECU) – The photographer shows extreme detail of a subject. This usually takes one component of a close-up frame and gets very close to it.

Group Shot (GS) – used when two or more subjects are in the picture. Each subject needs to be spaced correctly for this shot to look good!

Over-the-Shoulder Shot (OSS) – uses two subjects. The photographer takes a picture over the shoulder of one subject to the face of the other subject. This shot gives the audience the impression that they are listening in on a conversation.
Selfie Shot (SS) – a shot taken from a high angle.

Shot Framing

Rule of Thirds – the image is divided into nine sections (three sections vertical, three sections horizontal). Important parts of the picture should take up 1/3 or 2/3 of the picture either vertically or horizontally, but not both.



Headroom, looking room, and leading room – the amount of empty space around a subject. The more space around the subject, the smaller it can appear in comparison to other objects around it.
Important points of framing –

- Pay attention to the edges of your frame. Avoid cutting parts of an object out of the image, especially people!
- Avoid too much headroom in your image. This can make the subject look smaller than you intend.

Shot Angles

Eye-level – The most common shot where the subject is taken a picture of straight on.
High Angle – The camera is angled down toward the subject (most common in selfies)
Low Angle – The camera is angled up toward the subject
Bird's Eye – The picture is taken from directly above the subject or scene. Can be found in sports or Google Earth.
Bug's Eye – The picture is taken from a very low perspective, like what a bug on the ground would see.

Picture Orientation

Portrait – The image is taken vertically (the left and right edges are longer than the top and bottom edges). Usually taken in photos using a single subject or where a group is tightly grouped together (like a family photo).
Landscape – The image is taken horizontally (the top and bottom edges are longer than the left and right edges). This is more commonly found in photography.

Other Items to Think About when Taking Pictures

Leading lines – if there are lines that point toward a subject, use them! Be careful not to have lines sticking out of the person's body or head though!
Fill the Frame – Sometimes it is best to move closer to the subject so that you remove extra stuff from the image. Fill the frame with your subject and support it with other relevant items around it.
Find Repeating Patterns – If there is a lot of the same object repeating, use it to make an interesting image.

Appendix E – Implementation Log

Day 1 (40 minute class) –

First 5 minutes of class – Students select their partners. Students sit by each other to start the game so that they can be recorded on a score sheet.
5 minutes – General rules of the game are discussed with students. Questions can be answered based on the rules.
10 minutes – Students are given the opportunity to read through the guidance pages so that they know the shot types, distances, orientations, and composition components that will be asked of them for each round.
5 minutes – Students are given guidance on how to use the Airdrop function on the iPads. Students are also given instructions on not to change the camera setting to square, panorama, or grid so that they do not receive an unfair advantage over others.

Game round 1 –
Round criteria – Take an eye-level, mid-shot portrait of one of your group members
Time to complete – 5 minutes. Students must AirDrop the photo before the timer expires
When students are done taking pictures, they are to delete the photos they took from their iPad. This will ensure that iPads do not run out of storage and that students in other classes do not use their pictures and claim them as their own.

Post-round analysis (7-10 minutes)–
For each round, student work will be evaluated on the following criteria:

1. Does the picture meet the criteria established for the round (in this case, eye-level, mid-shot, and portrait orientation)?
2. Of the pictures that do, do those photos follow composition principles (rule of thirds, focused, shadows/lighting, is the picture level)?
    a. If enough pictures do not meet these criteria, the round can be redone and students can get a second chance (following guidance from McGonigal 2011 – freedom to fail and try again)

End of class activities –
Students return iPads to the cart for charging. Students also return guidance pages so that they do not study them outside of class.

Day 2 (80 minute class) –

Start of class – Students retrieve iPads and guidance pages.

Round 2 –
Round criteria – Take a wide shot of the classroom
Time to complete – 5 minutes
Students chose to try to get a picture of the classroom from as high up as they could get. The problem was that their pictures often included light fixtures that distracted from the photo

quality. Some students also had a problem with slanted classrooms, which were evident by students in the photo and slants in guiding lines around the classroom.

Post-round analysis (7-10 minutes) –
This analysis focused on the qualities of a wide shot – was a good amount of the classroom in the photo? Most students met that criteria and had a good deal of the classroom in view. The second part of analysis looked at the use of lines and if the classroom appeared tilted.

Round 3 –
Round criteria – Take a photo where the subject looks larger than it actually is.
Time to complete – 6 minutes

Post-round analysis (7-10 minutes) –
Feedback was focused on the two ways to get a shot where objects look larger than it actually is. The first analysis discussed the use of a low angle/bug's eye view of the object, while the second looked at the use of perspectives and distance (two subjects at different distances from the camera). Student misconceptions were cleared up about simply getting close to an object without any context from surrounding objects.

Round 4 –
Round criteria – Take a low-angle extreme wide shot of the mountains and sky.
Time to complete – 6 minutes (students were taken outside and given criteria before the timer was started – approx. 3 minutes each to enter and exit the building)

Post-round analysis (7-10 minutes) –
Feedback was given on how well the students captured the mountains and sky surrounding the school. Many students made sure to get as far away as they could from the mountains to take a good shot. This shot also gave an opportunity to discuss the rule of thirds and how it applies to good photo composition.

Round 5 –
Round criteria – Take an extreme close-up photo of an eye
Time to complete – 5 minutes

Post-round analysis (7-10 minutes) –
Student work was evaluated based on how well they filled the frame with their eye. Every student was able to meet this criteria, but there were problems with composition including cutting off a portion of the eye and focusing in on the shot. Overall, there were a lot of good pictures this round.

Closing class procedures – return iPads and guidance pages to their start-of-class locations.

Day 3 (40 minute class)

Round 5 –

Round Criteria – Take a bug's eye shot of the school
Time to complete – 6 minutes

Post-round analysis (7-10 minutes) –
Feedback focused on the difference between a low angle and a bug's eye view. Students were taking a picture from the perspective of a bug, but the angle was not large enough to be a bug's eye view. On-the-spot instruction was given and students were asked to reflect on pictures of skyscrapers taken, since that would be a bug's eye view that they were most familiar with. This round was often repeated with classes since there were no winners that met the base criteria.

Round 6 –
Round Criteria – Take a landscape group selfie (students could recruit members from another pair to give them more than two people in their picture)
Time to complete - 6 minutes

Post-round analysis (7-10 minutes) –
Selfies needed to be a high angle shot with the camera pointing down at students. Students also needed to include at least two people in the picture to be considered a group shot and taken with landscape orientation. Depending on the number of subjects in the picture, a small discussion was held to talk about how to space people in a picture to improve its composition.

Day 4 (40 minute class)

Round 7 –
Round Criteria – Take a close-up shot of something in nature
Time to complete – 6 minutes (3 minutes each were added to time to enter and exit the building)

Post-round analysis (7-10 minutes) –
Feedback revolved around making sure students looked at one part of the whole plant. Many students took excellent pictures of a part of a plant, such as the flowers of a sunflower or a fallen leaf in the grass. Feedback focused on making sure to highlight one part of the plant, as several pictures included lots of the same thing with no focus on a part of it. One class got the opportunity to redo this photo since only one of the photos met criteria.

Round 8 –
Round Criteria – Take a bug's eye view far shot of your best superhero pose
Time to complete – 6 minutes

Post-round analysis (7-10 minutes) –
This round looked to see if students understood a bug's eye view from the last analysis. Students demonstrated that they understood the bug's eye view angle and took very good far shot photos. Multiple points were awarded for this round.

Day 5 (80 minute class)

Round 9 –
Round Criteria – Take a high-angle landscape group shot with three people in it having a conversation.

Post-round analysis (7-10 minutes) –
Similar to previous rounds, feedback was focused on how a photographer is looking down on the subject. Several students took an eye-level picture and were reminded how to take a high-angle photo.

Round 10 –
Round Criteria – Take an eye-level close-up shot of two people staring each other down.

Post-round analysis (7-10 minutes) –
Most of the feedback for this round was based on taking clear pictures. Close-up shots have the potential of ending up blurry, which reduces photo quality.

Round 11 –
Round Criteria – Take a bird's eye view photo of somebody doing work.

Post-round analysis (7-10 minutes) –
Analysis focused on getting a true bird's eye view for this photo. Some students took a high angle shot instead of directly over their subject.

Round 12 –
Round Criteria – Take a low-angle medium close-up shot of one person trying to sell us something.

Post-round analysis (7-10 minutes) –
Many students did well with this picture, but several students are still taking photos from the mid-shot distance while others are taking close-up pictures.

Round 13 –
Winning pair picks the criteria for the round.

Day 6 (40 minute class)

For all rounds – Overall winning pair picks the criteria for the round.

Day 7 (40 minute class)

Distribute survey. Allow students full time to complete it.

Day 8 (40 minute class)

Distribute test. Allow students full time to complete it.
At end of test, debriefing script must be given.