THE EFFECT OF IMPLEMENTING GAMIFICATION PRINCIPLES IN A MIDDLE AND HIGH SCHOOL SCIENCE CLASSROOM

by

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ABSTRACT

Gamification is the application of principles commonly found in games and applying them to a non-gaming setting. The purpose of this study was to determine to what extent the effect of incorporating gamification principles had on a middle and high school science classroom. The effect on retention of material, the students' attitude towards science, and the impact these principles had on the teacher were included in this study. Results from this study suggest that while there was no discernable relationship between gamification and the retention of material by students, gamification principles did have a positive effect on the attitudes of the students regarding coming to class and participating in class. It was also determined that these principles had a greater impact on a middle school classroom and that for gamification to work, there needs to be a more thorough implementation of the principles which requires more commitment from the teacher.

INTRODUCTION AND BACKGROUND

Project Background

Video games are not a new development, by any stretch of the imagination. The first commercial arcade game was released in the early 1970s and ever since then video games have been ever present in society. They have even become incorporated into the educational system. Video games have been present in schools since the 1980s. Games such as *Oregon Trail*, *Reader Rabbit*, and *Math Blasters* were staples of my early childhood. Games like these taught us the fundamentals in an engaging way while at the same time, showing us that learning can be a fun and enjoyable experience. While these were a great use at the time, they soon faded into the background. Video games went from learning what hardships the pioneers met on the Oregon Trail to what button combination does it take to make a ninja throw a fireball or perform a series of spinning kicks (yes, I am looking at you *Mortal Kombat* and *Street Fighter*.) Now this is in no way an outcry against video games; I myself spend any spare time I have leading the New England Patriots to the Super Bowl on the latest rendition of *Madden*. The one question that has seemed to stick with me in my journey through my career in education is how can I apply video games, which seem to be present in all my students' lives, to my science classes to enhance their education? A possible answer was presented to me in the form of gamification. To put it simply, gamification is applying principles found in gaming into a non-gaming context. These would include principles such as gaining XP (experience points) through completing missions and side missions (assignments and

tests), "gaining new abilities" (lab activities), earning badges, and the use of "special abilities" (homework passes or receiving a free answer on a test).

Focus Questions

For my action research (AR) project, the ultimate question I hope to answer is: "does incorporating gamification principles influence students in a middle and high school science classroom?" This main question will be supplemented further by examining the following sub-questions:

- What effect does gamification have on a student's retention of the material?
- What impact does gamification have on a student's attitude towards science class?
- How does gamification compare in its effect on students in a middle school classroom versus a high school classroom?
- How has gamification modified my teaching habits?

CONCEPTUAL FRAMEWORK

Introduction

The definition of gamification itself offers a wide variety of applications. Sheldon (2012) defines gamification as "the application of game mechanics to non-game activities" (p. 75). As stated earlier, video games have been ever present since the 1980s. They seem to be even more mainstream today, with titles like *Candy Crush*, *Angry Birds*, and *Color Jump* burning up my students' batteries on their phones. Not only do these phone apps provide hours of entertainment, and frustration for some of my students, they also provide new methods for learning problem solving skills. Farber (2015) refers to this as "The Edutainment Era" (p. 16).

The idea of bringing games into the classroom has not had its detractors. Farber (2015) states that, "Educational games have a reputation of poor design. Many games were rushed to market and placed educational content ahead of game mechanics" (p. 16). The biggest negative remarks seem to come from those that believe that games, whether educational or not, do not really belong in the classroom. Bogost stated that "play and fun are often not associated with learning, and can be seen by some as not serious enough for effective teaching (as cited in Brull & Finlayson, 2016, p. 372). With the implementation of new concepts, there is bound to be some resistance. Hopefully this project will wade through the resistance and result in some positive outcomes.

Designing Gamification

Gamification is a relatively new concept. Because of this, a lot of the benefits that can come from gamification are more hypothetical than actual. Still, there has been some thought into how gamification should be implemented. Brull and Finlayson state that, "In order for gamification to work […] specific game mechanics need to be in place" (p. 373). In the same article, McGonigal states that "game mechanics need to be combined with achievable goals, rules, voluntary participation, and feedback to work (as cited in Brull & Finlayson, 2016, p. 373). This statement helped with the development of the methodology used in my treatment.

To make gamification work, the concept of setting goals and proper planning is a key issue. Kim (2015) states that, "considering various outcomes from a gamification project in advance and determining which outcome should be given the highest priority

can greatly facilitate the evaluation and improvement process of a gamification project" (p. 29).

When a goal has been clarified and the proper plan is put in motion, the last thing that should come into play is a student's motivation. Kim offers the following advice on that front:

> In designing gamification, we need to remember that gamification itself does not automatically generate motivation or engagement. For any gamification to succeed, it needs people's buy-in because they should care enough to play along. It is for this reason that the more closely the goal of gamification aligns with the goal of a player, the more successful the gamification will be (pp. 33-34).

Useful Mechanics

Once specified goals and thorough planning have been put into place, the last thing that is vital to a gamified classroom is what gaming mechanics will be implemented into the experience. A few of these mechanics that I have chosen to implement into my project is a leaderboard, badges, and avatars.

In gaming, leaderboards are meant to show how a player compares to the larger gaming community creating a sense of competitiveness. Of course, not all of us are competitive. Farber cautions that, "when misused, the leaderboard can discourage children from trying" (p. 123). To combat this, Farber suggests that, "it is important to emphasize to students that game scores are not grades" (p. 123). Driving this point home could help find that competitive balance.

In the gaming world, badges carry a little bit more to them than say a badge you would get from the boy scouts. Badges help not only show the level a player has reached in the game but also help show various achievements the player has achieved through

gameplay. Farber suggests that these can "promote a feedback loop of social participation" (p. 124).

Avatars are just the digital representation of the player inside the game. The good thing about avatar is that they allow students to be represented as a way that is completely different from what they are in real life. They also allow a little bit of silliness to enter play as most avatars allow players to be as creative as they want.

Gamification in the Classroom

Previous investigations into the use of gamification principles in a classroom have yielded a variety of results. The next few paragraphs will examine the results of some of these investigations.

The first study looked at what effect gamification had on a student achievement, mastery, and motivation in a science classroom (Reichelt, 2015). In this study, students were required to master 80% of the learning objectives to progress through a levelled set up for a general and dual enrollment anatomy & physiology courses. If mastery was not acquired, students could retest until they had mastered the needed material. Reichelt determined that for achievement, "although the model increases achievement for honors and non-honors students, non-honors benefited from implementation more than honor students" (p. 20-21). Reichelt also pointed out that there was a significant change in the students' motivation pretreatment vs. post-treatment. She goes on to state that her setup of the model "allowed students to be both intrinsically and extrinsically motivated" (p. 21).

The next study examined the impact of digital game-based learning (DGBL) on educational effectiveness and student motivation (Papastergiou, 2009). In this study, a sample of 88 students (46 boys and 42 girls) were separated randomly into two study groups: one that used the gaming application and one that didn't. This study found that, "the DGBL approach was both more effective in promoting students' knowledge of computer memory concepts and more motivational for students than the non-gaming approach" (p. 10). The study also found that, "the learning gains that boys and girls achieved through the use of the game did not differ significantly" (p. 10).

The next study looked at the practical implications and outcomes of a gamified experience (Dominguez et al., 2013). This study focused on first and second year college students from varying majors that were separated into two sections of a spring semester course. One section was used as the control group where no gamification was used and the other section was considered the experimental group and were exposed to a gamified course. At the end of their research, Dominguez et al. determined that students in the experimental group, "performed better on all items that were concerned with practical application of concepts" (p. 386). They go on to say that these same students "performed lower than the control group on the written examination and perception" (p. 386). They also found that "gamification can have a great emotional and social impact on students, as reward systems and competitive social mechanisms seem to be motivating for them" (p. 391).

In their 2015 study, Hanus & Fox tested students across two courses in a 16-week semester. They measured the students for their motivation, social comparison, effort,

satisfaction, and academic performance at four different points throughout the 16-week study. As the study progressed, Hanus & Fox noted that students in the gamified course, "tended to decrease in motivation, satisfaction, and empowerment relative to the non-gamified course" (p. 159). They also noted that students in the gamified course were, "less intrinsically motivated and in turn lower exam scores than those in the non-gamified classroom" (p. 159).

METHODOLOGY

Description of Treatment

The implementation of the gaming principles covered an entire quarter of the school year which, in the past, has usually averaged about three to four chapters per class. This allowed the students full exposure to gamification. The content covered during this research varied with grade range and is explained in detail in a later section.

This research project was done in conjunction with an online gamified tracking platform called Class Craft. This platform allows the players (students) to create an avatar that they can then use to obtain experience points (XP), utilize powers using their avatar's action points (AP), and obtain gold pieces (GP) which can then be used to purchase new accessories for their avatar or powers. Players could also fall in battle if their health points (HP) dropped to zero. For example, if a student failed to turn in an assignment on time, he/she would lose health points depending on how many days the assignment was late (up to 10 HP). If he/she failed to turn in the assignment at all, he/she would lose 20 HP and fall in battle (die). This platform also allowed me as a teacher to

take content from some of my lessons and apply the gaming principles mentioned above to it.

As the class progressed through a chapter or unit, players were given various tasks to obtain XP. These tasks include coming to class prepared, participating in class by answering questions or partaking in random events, turning in assignments early or on time, and completing "side quests." Players could also receive XP based on the grade they obtained on an assignment or a test. As players garnered more and more XP, their avatar increased in level, which resulted in the availability of higher level powers and accessories.

Gold pieces (GP) could also be obtained through several different ways. If a player came to class ready and before the bell rings or handed in an assignment a day early, they would receive a set number of gold pieces. These could also be obtained if players volunteered to clean the lab area or lab equipment. These pieces could then be used to "purchase" new accessories for their avatars or obtain pets that they can then train to gain more gold pieces.

As the players progressed through a chapter or unit, they would inevitably run into some pitfalls. These included turning in assignments late or not at all, handing in assignments that were incomplete, or misbehaving in lab. This resulted in the player's avatar losing health points (HP) which served basically as the player's health. If their health fell to zero, the player would fall in battle and must perform a random sentence to resume the game. These included anything from copying a section of text to bringing a treat for the class.

Sample

Most of the students, grades 7th-12th, that were enrolled in a science class during the 3rd quarter of the school year were included in this study. Since there was no non-treatment group, this AR project is considered more like a descriptive study. This gave me a sample number of roughly 34. The classes included were my 7th grade life science class ($N_L = 4$), 8th grade physical science ($N_P = 9$), 9th grade earth science ($N_E = 5$), 10th grade biology ($N_B = 8$), and my 11th/12th grade chemistry ($N_C = 8$). As the treatment progressed, a lack of interest and several setbacks schedule-wise forced me to abandon the treatment with the 10th grade biology and 11th/12th grade chemistry classes. As such, no post-treatment data was obtained from them, but observational data will be noted in the Data and Analysis section of this paper.

Richey is in the middle of a highly agriculturally active area and most students come from families that farm or ranch in the area. The students are predominantly of Caucasian descent with English as their first language. The students are high achievers in school with an average GPA of 3.72 in the junior high (7th/8th grade) and an average GPA of 3.66 in the high school (9th-12th grade). The gender ratio at Richey Schools for grades seven through twelve is 16 males to 21 females. The school offers a free and reduced lunch rate, but there are very few students who utilize the program.

Timeline

As stated previously, the timeline for this project ran the length of the 3rd quarter in the 2nd semester. A more thorough breakdown can be found in Table 1. The length of time in which the project ran, allowed for a wide range of content to exposed to

gamification principles. For the seventh-grade life science class, this included the remainder of our vertebrate biology lessons and an examination of the integumentary, muscular, and skeletal systems for humans. For the eight-grade physical science, this included examining the basics of physics, Newton's three laws of motion, the physics associated with fluids, and the physics of machines and work. For the ninth-grade earth science class, this included studying the principles of meteorology such as the composition of the atmosphere, weather systems and maps, severe weather, and the principle of climatology.

Table 1
Research Design Schedule for AR Project

Activity	Instruments Used?	Dates
Informational letter and permission slip sent home to parents/guardians.	N/A	Jan. 2, 2017 (Return date set for Jan. 11, 2017)
Collect pre-project data	Likert Survey and Sample Interviews	Jan. 12th, 2017
Introduction of Project to students	N/A	Jan. 13th, 2017
Implementation of gamification principles	Daily journal observations of classes involved in project	Jan. 13th, 2017 through end of project (3/21/2017)
Completion of Project	Likert Survey and Sample Interviews	Mar. 21st, 2017

Data Collection

Table 2 shows a data matrix of the instruments that were used during the AR project and what questions (focus and sub) that each instrument would help answer.

Table 2
Data Collection Matrix

Research Matrix	Likert Surveys	Sample Interviews	Teacher Reflective Journal	Summative Assessments
Main Question	X	X	X	X
Sub-Question 1				X
Sub-Question 2	X	X		
Sub-Question 3	X	X	X	X
Sub-Question 4		X	X	

The Likert survey was given twice in the treatment process: once as a pre-treatment survey (Appendix A) and after the project (Appendix B). The sample interviews (Appendices C and D) were conducted at the beginning of the project and after the project. The teacher reflective journal (Appendix E) was kept throughout the course of the project.

The Likert survey was administered to all students involved in the treatment process and was designed to allow students to answer an open-ended question after their Likert responses. The questions used on the pre-treatment Likert survey were designed to focus on three areas: a student's attitude towards science class, the use of technology in a classroom, and their exposure to video games and gamification. The post-treatment Likert survey focused on any changes in a student's attitude when gamification principles were instituted and their general feeling about the gamification process overall. Most of the questions for both the pre-treatment and post-treatment surveys contained a numerical scale that ranged from one to ten, in addition to an open-ended question. The numerical responses the students answered on the scale were averaged and compared per the steps described below in the Data and Analysis section. Any qualitative responses from the

Likert survey that stand out (positively or negatively) were singled out and included in the Data and Analysis section.

The interviews were conducted individually with a random selection of students involved in the treatment process and were conducted in conjuncture with both the pre-treatment and post-treatment Likert survey. A random name generator was used to select the students and the interviews were conducted separately from the rest of the class. Both the Likert and interview questions gave an insight into how the students felt about gamification and technology being used in the science classroom. Both the surveys and the interview questions were examined by colleagues and professors to ensure they fit the goals of my study and the results of these would help to insure validity. The Class Craft platform itself also helped to ensure validity.

A student's performance on summative assessments were used to show any impact that the implementation of gamification principles had on a student's performance during assessments and the student's retention of the material in the classroom. By examining a student's test scores on units from a previous quarter to a student's test scores on a treatment unit or chapter, a comparison was made on the effect gamification had on a student's test scores. By triangulating these summative test scores with the responses to the Likert surveys and the responses from the sample interviews, I could determine, both from a quantitative and qualitative standpoint, what effect gamification had on a high school and middle school science classroom.

The reflective journal was the only instrument that was ongoing throughout the duration of the treatment. As the treatment progressed, entries were made based on my

observations of students' attitudes and their responses to what was going on in class. I also made entries on other observations that I made throughout the course, such as comments made by students and performance on other aspects of class. By looking at these entries, I could determine to what effect gamification had on myself as a teacher.

Before and during the project, students were reminded that participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way. The research methodology for this project received an exemption by Montana State University's Institutional Review Board (Appendix F) and compliance for working with human subjects was maintained.

DATA AND ANALYSIS

Pre-Treatment Likert Analysis

After administrating and collecting of the pre-treatment Likert survey (Appendix A), the responses were recorded into an Excel spreadsheet. The frequency of responses can be seen in Table 3. This table records how many times a numerical response was given for each question. The frequencies of responses to each question has been averaged.

Table 3
Frequency of Responses to Pre-Treatment Likert Survey Questions (N=31)

		1	2	3	4	5	6	7	8	9	10	Avg.
Survey Questions	Q1	0	0	1	3	3	4	6	6	7	1	7.00
	Q2	1	0	0	2	1	4	8	3	6	6	7.48
	Q4	1	0	2	2	6	3	5	10	1	1	6.35
	Q5	1	0	1	1	8	4	4	8	2	2	6.52
	Q6	1	1	0	0	8	8	8	2	2	1	6.18
	Q7	4	5	1	7	1	3	2	4	1	3	4.95
	Q8	1	0	1	2	7	3	9	1	1	6	6.63

Note. The top row of values represents a scale of 1-10 for responding to the questions on the pre-treatment Likert survey (*N*=31*).*

From the table above, it can be shown that the two questions that dealt with students' attitude towards science (Q1 and Q2) had the two highest averages and had the most frequent responses in the higher end of the 1-10 scale on the Likert survey. Questions that dealt with technology in the classroom (Q4, 5, and 6) showed an average that was slightly above the mid-range value of five and were all within about 0.34 points of each other. Questions regarding video games showed the greatest difference in values. The average value for responses on a student's experience with video games was slightly below the mid-range value of five whereas the average value for responses to the set-up of a classroom like a video game was above the mid-range value of five. From the data, students already enjoyed coming to class and were highly motivated to do well in it. The use of technology in the classroom intrigued the students, as did the aspect of having a classroom set up as a video game, even though not all students involved in the study had been exposed to video games.

Figure 1 shows a breakdown of the responses for question three since this was the only question not to have a numerical response attached to it.

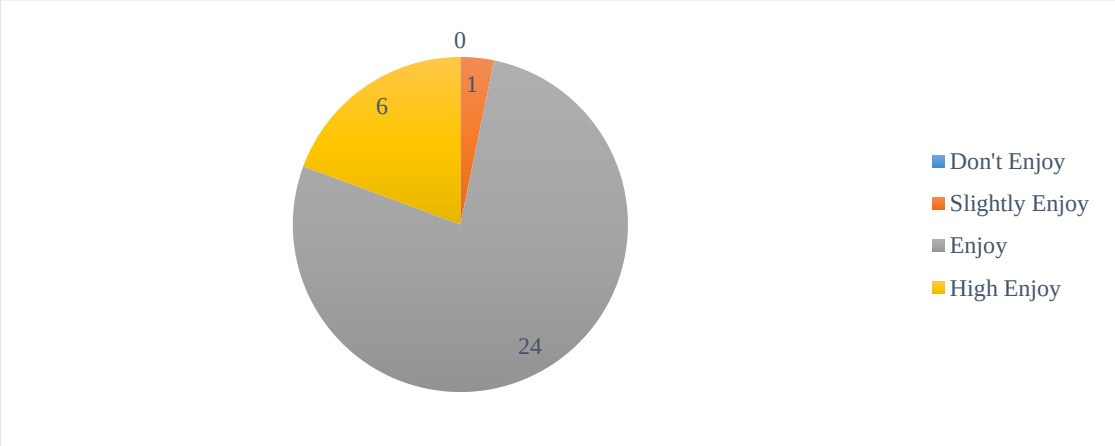

Figure 1. Breakdown of responses to Pre-Treatment Survey question 3, (N = 31).

Of the 31 responses, zero responded as saying they don't enjoy science class, one responded by saying that he/she slightly enjoys science class, 24 responded by saying that they enjoy science class and six responded as saying they highly enjoy science class.

Breakdown of Data by Gender

Table 4 and Figure 2 shows a breakdown of the data obtained by the pre-treatment Likert survey by gender.

Table 4
Average Score for Pre-Treatment Likert Survey by Gender

Survey Question	Q1	Q2	Q4	Q5	Q6	Q7	Q8
Average Score for Males	7.14	6.71	6.79	6.64	6.43	6.75	7.39
Average Score for Females	6.88	8.12	6.00	6.41	5.97	3.47	6.00

Note. Average score is based off number of responses by each gender. For males, this number is 14 (*N*=14) while for females this number is 17 (*N*=17).

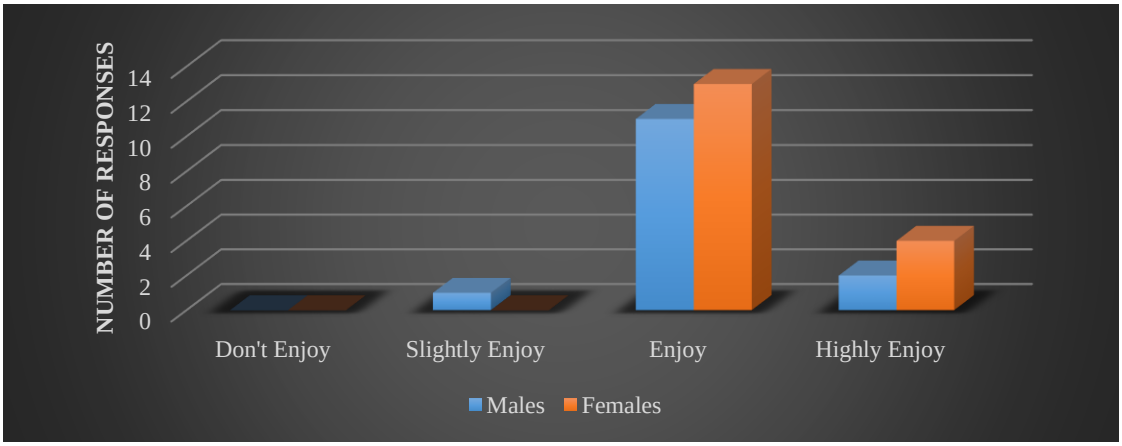

Figure 2. Breakdown of responses to Pre-Treatment Survey question 3 by gender.

A breakdown of the gender data from Table 4 shows that both males and females were nearly even in value for the question on how much they enjoyed coming to class (Q1). This can also be seen from Figure 2, which shows that regardless of gender,

students enjoyed coming to class. The genders were also very similar in value for the questions that relates technology to the student's attitude towards science (Q4, 5, and 6). The biggest gaps were in questions two and seven. While both genders showed a similar value for how much they enjoyed coming to class, the average value for females was higher than the males for wanting to do well in science (Q2). In terms of experience with video games (Q7), males had a higher value, and therefore a higher experience level, than females did.

Breakdown of Data by Grade Level. Table 5 and Figure 3 shows a breakdown of the data obtained by the pre-treatment Likert survey by grade level.

Table 5
Average Score for Pre-Treatment Likert Survey by Grade

Survey Question	Q1	Q2	Q4	Q5	Q6	Q7	Q8
Average Score for Grade 7	4.75	8.00	5.25	5.25	6.50	5.50	7.00
Average Score for Grade 8	5.86	7.14	6.14	5.71	5.43	5.21	5.79
Average Score for Grade 9	8.50	6.25	7.50	7.75	6.50	5.50	7.75
Average Score for Grade 10	8.00	8.38	6.25	6.75	6.00	4.00	6.00
Average Score for Grade 11	7.20	6.80	6.60	6.20	5.70	5.20	6.80
Average Score for Grade 12	7.67	8.00	6.67	8.33	8.33	5.00	8.00

Note. Average scores are based off the number of responses received in each grade. The numbers for each grade are 7^{th} = 4 (N_7=4), 7 for 8^{th} (N_8=7), four for 9^{th} (N_9=4), eight for 10^{th} (N_{10}=8), five for 11^{th} (N_{11}=5), and three for 12^{th} (N_{12}=3).

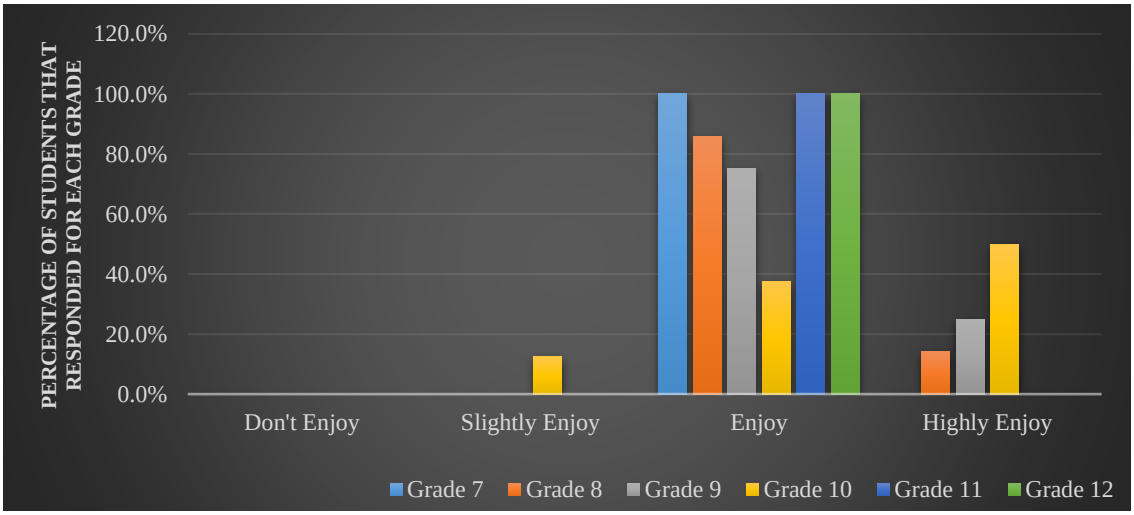

Figure 3. Breakdown of Pre-Treatment Survey responses to question 3 by grade level.

A breakdown of the grade level data from Table 5 shows a wide variety of values. For example, when asked about how much the students enjoyed coming to class, the values for grades seven and eight were close to mid-value while the values for grades 9-12 had a high average. Regardless of the differences in average value, all students in grades 7-12 responded that they enjoyed the current set up of class, as seen in Figure 3. When asked about their motivation for doing well in science class, grade 9 had the lowest average value while the other classes had high average response values. There was one average value that stands out from the data in Table 5 related to technology use in class. When asked about the impact technology could have on changing their attitudes towards class, the senior class had the highest values for questions 5 and 6. Overall, the deduction made from the grade level data is that while all students involved in this study enjoyed the set-up of class and wanted to do well, the junior high students did not enjoy coming to class as much as the high school students did. It can also be deduced that high school students were more open to using technology in class than the junior high students. A

more thorough examination of the two schools (middle and high) is explored in the next section.

Breakdown of Data by School (Middle vs. High). The following table (Table 6) and figure (Figure 4) shows a breakdown of the data when compared between middle school students (those in grades 7 and 8) and high school students (those in grades 9-12).

Table 6
Average Scores to Pre-Treatment Likert Survey Separated by Middle School and High School.

Survey Question	Q1	Q2	Q4	Q5	Q6	Q7	Q8
Average Score for Middle School	5.45	7.45	5.82	5.55	5.82	5.32	6.23
Average Score for High School	7.85	7.50	6.65	7.05	6.38	4.75	6.85

Note. Average scores are based off responses from middle school students (N_m=11) and high school students (N_h=20).

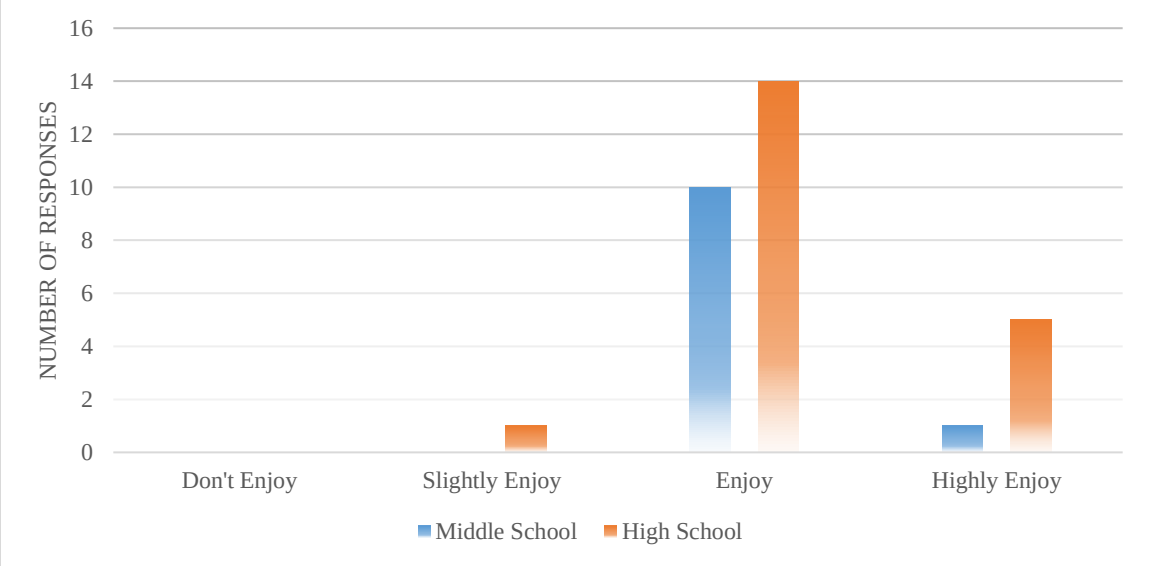

Figure 4. Breakdown of responses to Pre-Treatment question 3, middle school vs. high school.

The breakdown of data by schools (middle vs. high) offers a more generalized look at how the different grades responded to the Likert survey. While high school students had a higher average value when questioned about their enjoyment of class (Q1), they had a similar value as the middle school students when questioned about their motivation to perform well in science. This is also apparent from Figure 4, which shows that most students, regardless of school, either enjoyed or highly enjoyed science class. This echoes what was seen in the data from the breakdown by grade level in a previous section and shows that junior high students did not enjoy coming to science class as much as high school students, but wanted to do just as well in class as the high school did.

When questioned about the use of technology in class and the effect it could have on a student's attitude towards class, high school students tended to have higher averages than middle school students. This echoes what was seen in the grade level data from above and shows that high school students are more interested in using technology in class than junior high students are.

The one question where the middle school students had a higher average value then the high school students was their exposure to video games. Although not significantly higher, the middle school students had an average value that was 0.57 points higher than the high school students. Both schools were close (0.42 points) when questioned on their interest in a gamified classroom, with the high school students having the higher value. Based on this data, it can be deduced that while exposure to video games occurred more at the junior high level, the high school was more interested in a gamified classroom experience than the junior high was.

Pre-Treatment Interview

Through a random selection process, I selected a small sample size of students (2-3) from all the classes to participate in the interview part of the pre-treatment process. A copy of the questions used during the survey can be found in Appendix C. Half of the questions that were asked during the interview pertained to the students' attitudes towards science, while the other half pertained to gamification and gaming exposure.

Of the students interviewed, the overwhelming consensus was that students were learning in class. Another question that garnered an overwhelming response was what aspects or activities did they enjoy. Overwhelmingly, students responded that they enjoyed labs or hands-on activities the most. One student said, "the presentations, because it helps me on the test." This echoes what was seen in the pre-treatment Likert survey data mentioned above, when it was determined that on average, students were highly motivated to do well in science. When questioned about if they find science interesting, the responses varied slightly. Almost half of the students that were interviewed said that they found science interesting. The remaining students' responses were along the lines of, "it depends on what we are learning" or "I find certain aspects interesting." One student responded that she found it interesting, "when I know what we are talking about or enjoy the subject."

Of the students interviewed, an overwhelming consensus was given for whether they had heard of gamification before. The overwhelming consensus was that students had not heard of gamification before. When questioned about their exposure to video games, most students had very little to no exposure. One student responded with a no,

"unless you count competitive family Wii sword fishing. Also, *Panda Pop* clutch." I told her that was a yes. A few students responded that they had had some exposure either through "various consoles" or "flash games on the computer that we aren't supposed to be on in school." One student responded that he had "six years [of experience], across various platforms." He went on to say that he "built his own PC geared towards gaming." When questioned about their interest in a class that incorporated gaming principles, most students responded that they would. When probed to explain their response, some students responded that "it would be fun to participate in," or that "it would be cool to try something different in class." One student responded that it might, "add a whole new aspect to learning and school." A couple students responded that they were "unsure but willing to try." A couple of students responded with a no and when asked to elaborate, one student said that she, "didn't like video games, but wouldn't care if we did unless it affected her understanding [of the subject]." The other student responded that she thought that, "high school students should have the ability to learn from a textbook." This was echoed in her Likert survey responses that were low for using technology in the classroom and gamification questions.

Summative Assessment Data

To measure any impact that gamification had on a student's retention of the material, test scores from a quarter where the treatment was not used were compared to test scores from the quarter in which the treatment was used. As stated previously, lack of interest and scheduling conflicts limited the number of students to pull a random sampling from. Because of this development in the treatment process, I compared the

test score for all students that were involved in the treatment. The following figures show a comparison of the test grade from the treatment quarter to a quarter in which the treatment was not used for the 9th (Figure 5), 8th (Figure 6), and 7th (Figure 7) grade classes.

9th Grade Test Scores

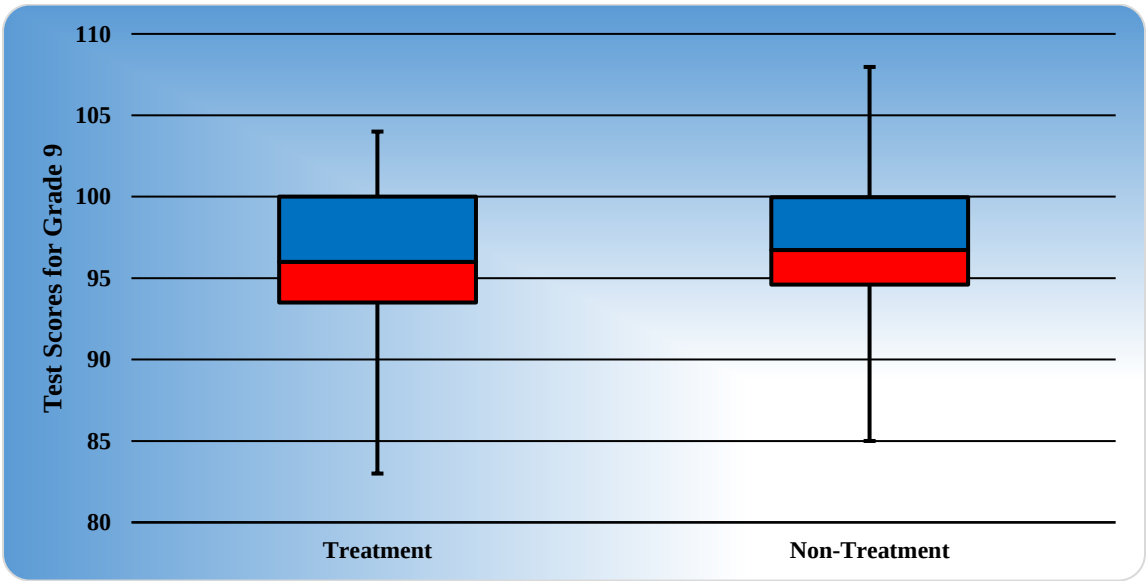

Figure 5. Comparison of test scores for 9th grade class, treatment quarter vs. non-treatment quarter (*N* = 5).

The figure above compares the test scores for the quarter in which gamification was used (Treatment) and a quarter in which gamification was not used (Non-Treatment). The test scores for each quarter had almost the exact same median score. The range of scores were also similar between the two quarters (21 for treatment vs. 23 for non-treatment).

One way in which the plots differ in scores is the distribution of scores in the top half of the treatment quarter. During the quarter in which gamification was used, the distribution of scores in the top half were not as spread out as they were for the quarter in

which gamification was not used. This means that there were more students receiving those higher test scores during the time that gamification was in use. However, it is unclear on whether this is directly related to the use of gamification or not.

It is noteworthy to point out that the content between the two quarters did differ. As stated earlier, the area of study during the quarter in which the project was in progress dealt primarily with concepts related to meteorology. During the quarter in which test grades were pulled for comparison, the focus of study was on the differences processes that shape the Earth's surface, such as landslides and surface water movement. Since neither of these were more difficult than the other, and the method of reviewing and taking tests did not differ between the two quarters, it is unlikely that this difference played a role in the difference in scores seen in the ninth-grade.

8th Grade Test Scores

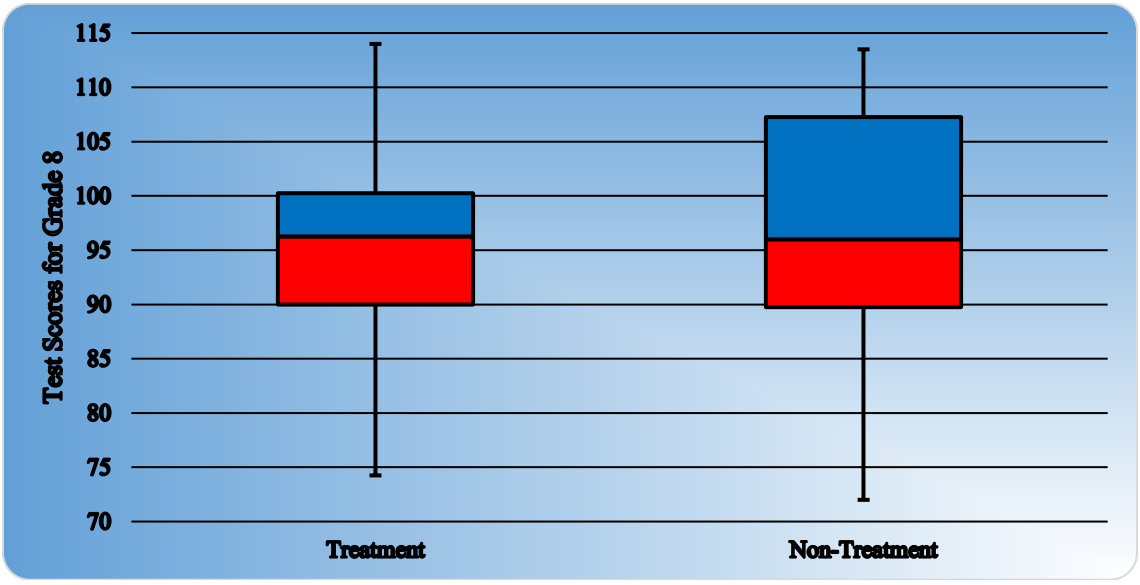

Figure 6. Comparison of test scores for 8th grade class, treatment quarter vs. non-treatment quarter *(N*=9*)*.

Much like the 9th grade scores, the test scores for the 8th grade class were similar in range and median test score. The bottom half of the test scores were similar as well when comparing the quarter in which gamification was used to the one in which it is not. A big change can be seen though in the top half of test scores. The range for the top 25% of test scores (the fourth quartile) increased in the quarter in which gamification principles were used. In response to that, the range of scores in the upper 25% of test scores (the third quartile) decreased in the quarter in which gamification principles were utilized. This would indicate that the number of test scores that received the highest marks increased in the quarter in which gamification was used. It is unclear, however, if gamification was the cause of this or there was another factor involved.

Much like with the ninth-grade class mentioned above, the content covered between the two quarters varied for the eighth-grade as well. As mentioned earlier, the quarter in which the project was implemented for the eighth-grade dealt primarily with concepts found in physics. In the case of the eighth-grade, the quarter in which comparison scores were pulled dealt primarily with concepts related to chemistry, such as chemical reactions and acid/base properties. It is unclear if this change in concept had any effect on test scores as the reviewing method and testing procedures did not change. What did change was the presence of more math related problems with the physics quarter and some of the students did struggle with that conversion. It is unclear, however, whether that played a significant part in the change of scores.

7th Grade Test Scores

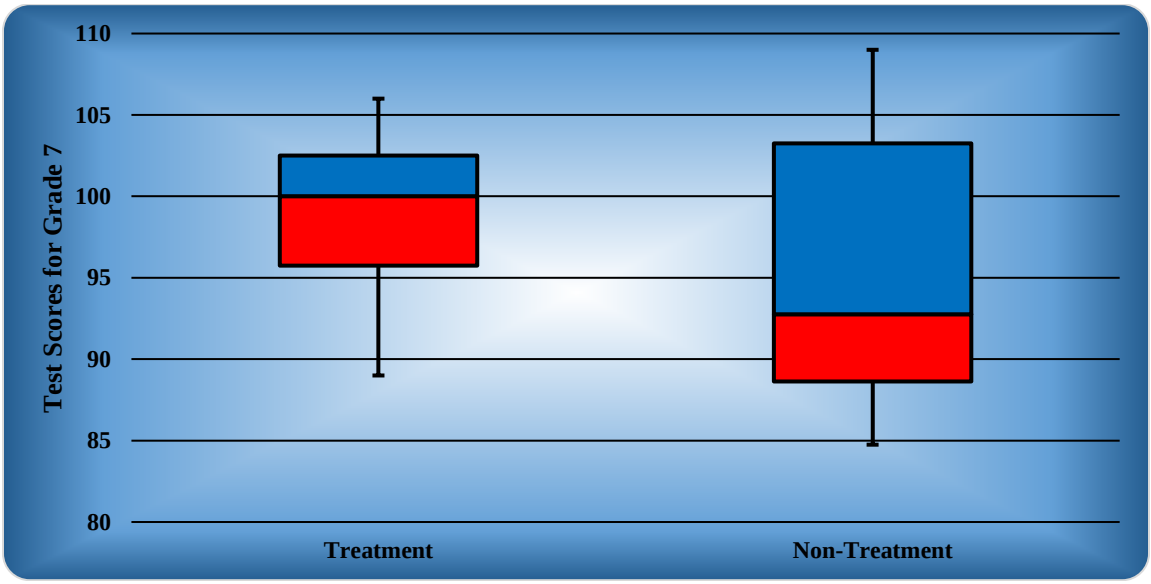

Figure 7. Comparison of test scores for 7th grade class, treatment quarter vs. non-treatment quarter *(N*=4*)*.

The 7th grade test scores show the greatest change in going from a quarter in which no gamification was used to a quarter in which gamification was used. The first major change was the median test scores went from the low 90s in the non-treatment quarter to 100 in the treatment quarter. The range of values also decreased significantly in the treatment quarter. The test score ranges for the first two quartiles increased in the treatment quarter. This could either be an increase in test scores for those lower earners or those that were receiving high test scores in the non-treatment quarter were now receiving slightly lower test scores during the treatment quarter. While it is unclear whether this can be attributed directly to gamification, it is promising to see an increase in the lower half of the test scores.

Unlike with the ninth and eighth-grade classes, the concept that were being covered between the two quarters for the seventh-grade class did not change, as the class was exploring organismal biology over the course of the two quarters. One difference however, was the during the non-treatment quarter, the primary focus of study was on invertebrates and not vertebrates as was the case in the treatment quarter. The unfamiliarity with invertebrates may have played a part in the change in test scores, but it is unclear to what extent, if any, it had on test scores.

Post-Treatment Likert Survey Analysis

After the treatment process, a post-treatment Likert Survey (Appendix B) was given to those students who finished the treatment and the results were tabulated in an Excel sheet much like the pre-treatment survey was done. Table 7 shows the students' response to the question on the survey and how many times that response was recorded, as well as the average value for responses to each question.

Table 7
Summarized Responses to Post-Treatment Likert Survey

		1	2	3	4	5	6	7	8	9	10	Avg.
Survey Questions	Q1	0	0	0	1	2	1	4	4	5	1	7.50
	Q2	2	4	2	3	4	0	1	1	1	0	4.00
	Q4	0	0	2	4	0	2	3	4	2	1	6.39

Note. The top row of values represents a scale of 1-10 for responding to the questions on the pre-treatment survey (*N*=18).

Table 7 shows that once we started using Class Craft, students that were surveyed responded highly on the scale that they enjoyed coming to class but responded in the low to mid-range on the scale when questioned on whether Class Craft influenced their motivation to come to class. The average values reflect this with question one having an

average that would be on the high end of the scale, while question two has an average below the mid-value range. Responses were in the mid-range to high end when asked if they enjoyed a class that utilized gamification principles which is also reflected in the average for question four. This indicates that while students still seemed to enjoy coming to class, the use of a gamification platform like Class Craft was not the driving force for that enjoyment. I examined the responses to the open-ended questions on the Likert survey, but found most of those responses blank or left with an IDK (I don't know).

Figures 8 and 9 shows a breakdown of the responses to Questions 3 and 5 since those did not have any numerical value to them.

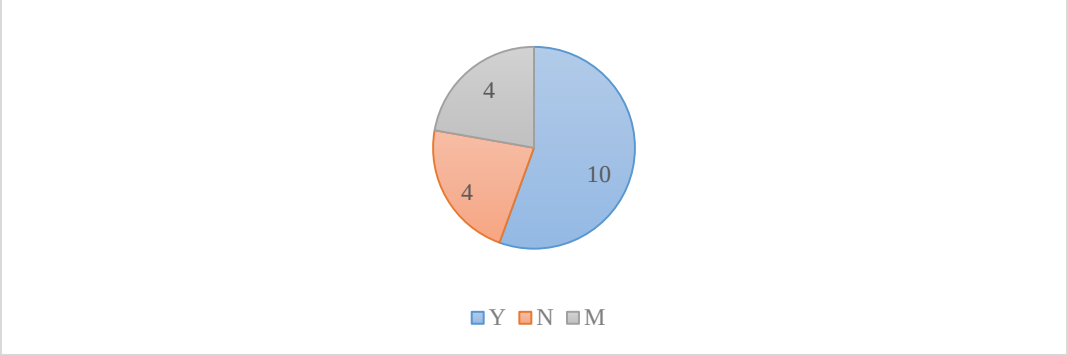

Figure 8. Breakdown of responses to question 5 from Post-Treatment Likert Survey (*N*=18).

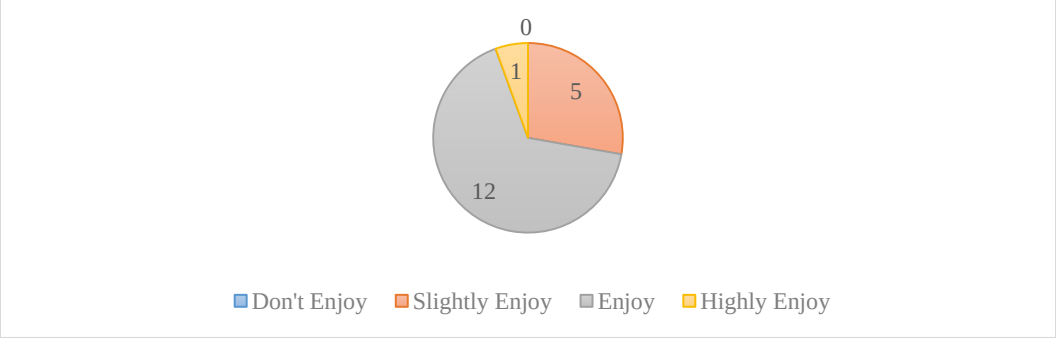

Figure 9. Breakdown of responses to question 3 from Post-Treatment Likert Survey (*N*=18).

Figure 8 shows that while a good portion (72.2%) of the students enjoyed or highly enjoyed the changes to class, 27.8% of the students answered that they only slightly enjoyed changes made in class. When examining the responses for question five, it was found that 77.8% of the students said that they might enjoy a class that utilized gaming principles more in depth in the future, while 22.2% of the students would not. What these values indicate is that while the amount of gamification that was used had no significant impact on a student's enjoyment of class, enough of it was used to intrigue the students enough that they might be open to doing a more in-depth use of gamification in the future.

Much like the pre-treatment data, this data is further broken down by gender and grade level. Unlike the pre-treatment data, however, the post-treatment data will not be broken down by middle school vs. high school as the number of students in the high school dropped due to the reasons mentioned before.

Breakdown of Data by Gender

Table 8 and Figures 10 and 11 show a breakdown of the post-treatment Likert survey by gender.

Table 8
Average Score for Post-Treatment Likert Survey by Gender

Survey Question	Q1	Q2	Q4
Average Score for Males	7.60	4.10	6.90
Average Score for Females	7.38	3.88	5.75

Note. Average scores were based off the number of males (N_m=10) and females (N_f=8) that completed the treatment.

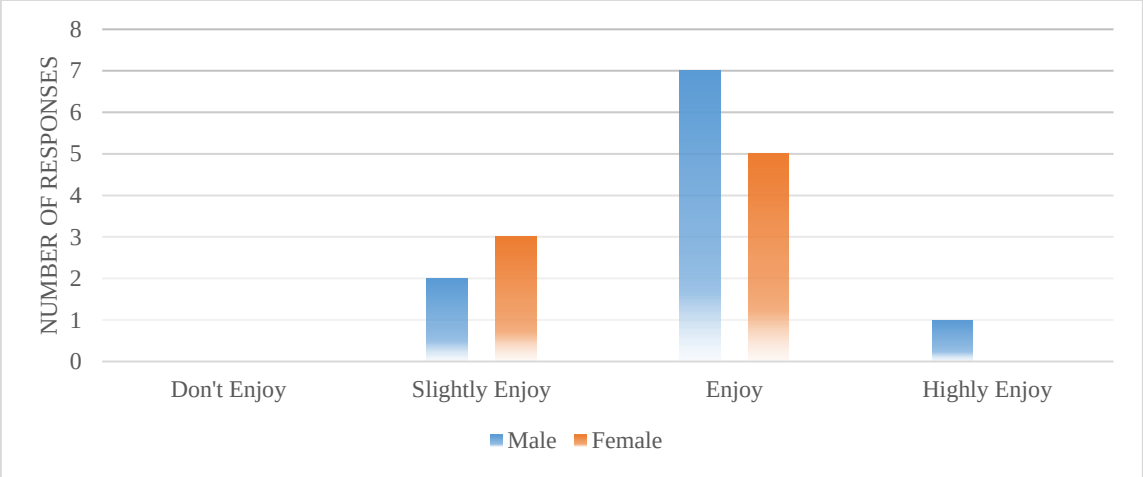

Figure 10. Breakdown of responses to question 3 of Post-Treatment Survey by gender *(N*=18*)*.

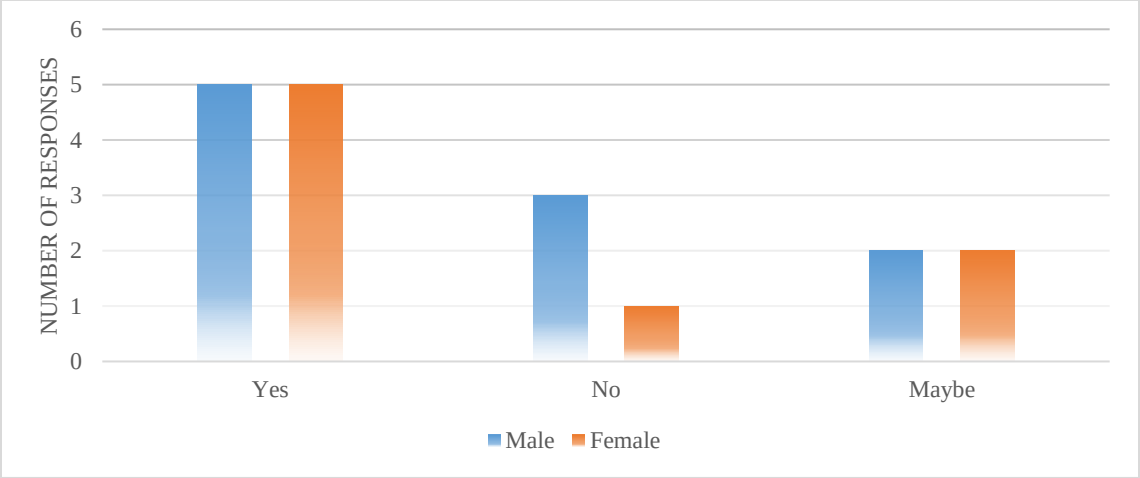

Figure 11. Breakdown of responses to question 5 of Post-Treatment Survey by gender *(N*=18*)*.

The breakdown of the post-treatment data by gender shows very similar answers to the Likert survey by both males and females. The average values for both questions one and two were only 0.22 points away from each other. The biggest difference was in question four in which males responded with a higher average value when asked whether they enjoyed the inclusion of gamification principles. This can further be seen from the

data in Figures 10 and 11 which show that 80% of the males enjoyed or highly enjoyed the changes to class and 70% would or might enjoy the use of these principles in the future.

Breakdown of Post-Treatment Data by Grade Level. Table 9 and Figures 12 and 13 show a breakdown of the post-treatment Likert survey by grade.

Table 9
Average Score for Post-Treatment Likert Survey by Grade

Survey Question	Q1	Q2	Q4
Average Score for Grade 7	7.25	3.75	6.00
Average Score for Grade 8	7.44	3.33	7.44
Average Score for Grade 9	7.80	5.40	7.00

Note. Averages are based off the number of students in Grade 7 (N_7=4), Grade 8 (N_8=9), and Grade 9 (N_9=5) that completed the treatment.

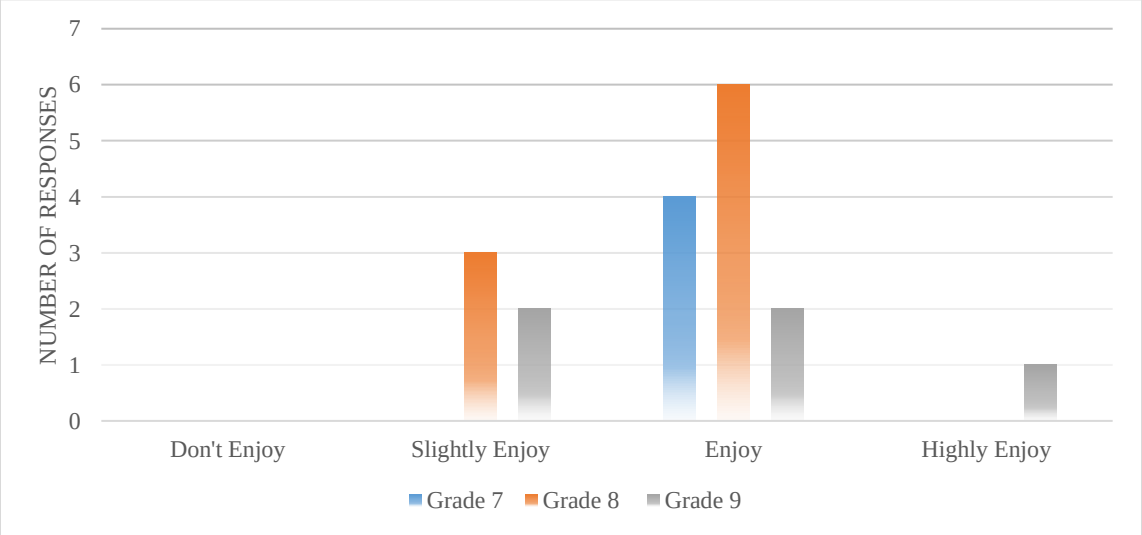

Figure 12. Breakdown of Responses to Question 3 of Post-Treatment Survey by Grade *(N*=18*)*.

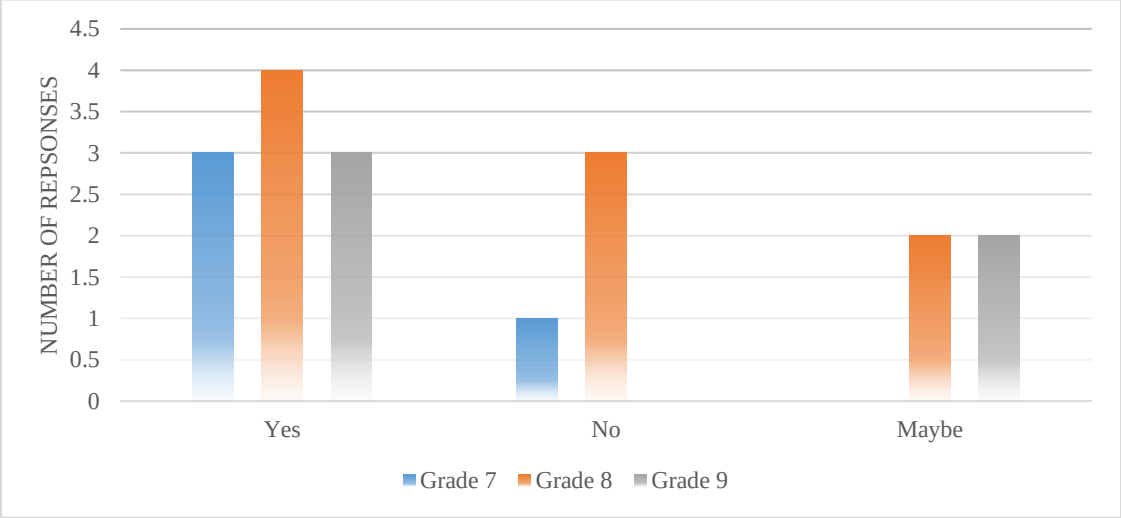

Figure 13. Breakdown of Responses to Question 5 of Post-Treatment Survey by Grade *(N*=18*)*.

The data breakdown for the post-treatment survey by grade level shows a wide range of results. While all grades had very similar responses when questioned about how much they enjoyed coming to class once Class Craft started, the other questions showed striking differences. When questioned on Class Craft's effect on a student's motivation, grades 7 and 8 had a very low average, while grade 9 had an average that was in the middle. This indicates that using Class Craft motivated those students more than grades 7 and 8. The average responses for the question dealing with enjoying a class that used gamification principles had the widest range of responses. Grade 8 had the highest average, while grade 7 had the lowest average.

Post-Treatment Interview

After the treatment process, a few random students were chosen to complete the interview questions found in Appendix D. Much like with the pre-treatment, there were some similar responses to the questions and some differences to others.

Of the students interviewed there were a few common aspects of the treatment that were brought up that the students seemed to enjoy. One of these aspects was the use of powers in class. Powers would allow students to either turn in assignments that were late with no consequence or skip over an assignment entirely. One student interviewed said that this "made it seem like there was less pressure on him and he didn't have to worry about too much about a late grade." Another student responded that she enjoyed having the option of skipping an assignment because she was involved "in a bunch of different things" and it lessened the pressure of getting something done. One student said that he just liked the idea of "skipping an assignment that he didn't want to do." Another aspect that was brought up during the interviews that students seemed to enjoy was the Random Event activities. These were usually done at the beginning of class and varied from tasks that needed to be down or random activities for XP. One of the students interviewed said that this made the class more enjoyable and made it feel more like a random event that you might find while playing a game. I just think she enjoyed the ones that made me do things like end sentences with a meow or sing the chorus to a song that the class chose.

Another question where similar responses were given, was the question on if the gamification principles helped the students throughout class. The general thought was that the gamification process had no effect on their retention of the material or didn't help them because it wasn't utilized enough to have an impact on the student's performance in class. One student commented that even while using Class Craft, she relied more on the Quizizz reviews and her study guide to study for tests. One student claimed that he

remembered more about a topic because of the lab that was done over it then what was done through Class Craft.

The other question where I saw a split in the responses is the question on their interest in a class that was set up like an RPG game like Class Craft. While the overwhelming consensus was that there was some interest in a class set up like an RPG game, it would depend on how it was set up and how much in depth it went. One student even commented that it seemed like we only "scratched the surface with something like this."

Impact on the Teacher

As the treatment progressed, I kept a journal of my observations for the classes involved. Excerpts from this journal can be found in Appendix E. There are a few areas of emphasis that can be taken from these excerpts. The first aspect is that student interest started out strong but soon waned. Even in the students that finished the treatments (7th-9th grade) there was some waning in interest. As noted in the March 10th entry, one student has said that she, "doesn't care anymore" since she "has all the things I can get for my character.

Another area during the treatment that I did notice and make note of was the number of assignments turned in. As mentioned in the March 10th entry, I noted that one student had not had a missing assignment grade since February 10th. This was true for a few other students who had had a history of not turning in assignments. This could be influenced by the gamification principles as students would lose health points and fall in battle if they missed an assignment.

The last area I am going to address was the time commitment the treatment required to keep up with the student's avatars. As we progressed through the units, side quests were created to ensure students could gain as much XP for their avatars as possible. While this only ended up being for three of the classes I started out with, I found most of my prep time (about 56 minutes) and any free time in my other classes to try and find adequate side quests that could be applied to the content being covered. This is noted in the March 1st entry found in Appendix E. This would take time away from planning for my other classes as well as the grading that needed to occur, since that was another area that students could gain XP in. This may have seemed more like it was pulling time away from other classes because it was the first time that these concepts were being used. In subsequent years of use, practice and familiarity could turn this into a time saver and not seem like its pulling vital time away from other areas.

INTERPRETATION AND CONCLUSION

Re-addressing the Focus Questions

At the onset of my project, the ultimate question I hoped to answer was, "Does incorporating gamification principles influence a middle and high school science classroom?" The following sub-questions were meant to help supplement my focus question and provide a more in-depth analysis of my research:

- What effect does gamification have on a student's retention of the material?
- What impact does gamification have on a student's attitude towards science?
- Does gamification benefit a middle school classroom or high school classroom more?

- How has gamification modified my teaching habits?

Student's Retention of Material

The question on what effect gamification has on a student's retention of the material can be seen in the summative assessment data. The timing between teaching and assessment varied with the classes used during the treatment process, but a review session was always done the day before the test. On average, this occurred within a week of when the lesson was given, not including days where students missed for extracurricular activities and labs. From the box and whisker plots found in the summative data section above, test scores changed during the quarter in which gamification principles were utilized. Unfortunately, the results of these test scores cannot be directly linked to the se of gamification principles, as the review processes used from previous quarter were still used during the treatment. However, there may have been an indirect influence that can be attributed to gamification. As mentioned in the "Impact on Teacher" section, through my daily observations, I noticed that one student had a decrease in the number of missed assignments. This could be linked to the loss of health points (HP) mentioned in the treatment section. An increase in the amount of homework assignments turned in could correlate to an increase in the material that the student remembers writing about which could indicate that the gamification influenced the retention of material, albeit indirectly. Further study would need to be done where gamification is used solely as a review process before a test is taken.

Student's Attitude towards Science Class

To determine if gamification had any impact on a student's attitude towards science, we must compare the responses of the students to the Likert surveys given both pre-treatment and post-treatment. Per Table 3, questions pertaining to a student's attitude towards science and class in general (Q1 and Q2) had a relatively high average value for responses (7.00 and 7.48 respectively). These values can indicate that students were already motivated to come to class and had a high drive to do well in science class. This is mimicked in Figure 1 which shows that of the 31 students that completed the pre-treatment Likert survey, roughly 77% enjoyed the current set up of class while roughly 19% highly enjoyed the current set up. Of the students that completed the treatment this number, 100% of the students responded that they enjoyed the current class set up.

Per Table 7, questions pertaining to a student's attitude toward class since the implementation of the treatment (Q1 and Q2) had an average score of 7.50 for Q1 and 4.00 for Q2. These values indicate that students still enjoyed coming to class but only increased slightly, while their motivation to come to class only increased slightly. The responses to Q3 (as shown in Figure 9) show that students' enjoyment of class changed during the treatment process. Of the students that finished the treatment, the number of students that enjoyed the class dropped from 100% to 67%, while 28% of the students responded as only slightly enjoying the changes in class. This could be a combination of the changes to class, as well as the general dreariness that all students feel by the time 3rd quarter rolls around. I did notice that towards the end of the treatment process, the

number of log-ins by students started to decrease and comments such as "I don't care anymore," started to increase.

High School vs. Middle School

As mentioned before, initial excitement for the project in the higher grade was soon replaced by a lack of interest. The number of log-ins by students in the higher grade drastically decreased in the first week. After setting up their avatars, these students rarely participated in the other aspects of class. Some of this could be a lack of interest, but some of it also could be attributed to scheduling conflicts. In the future, this might only be used for a single unit instead of fully integrated.

Most of the students at RHS are heavily active in extracurricular activities such as sports or FFA and in a small school like Richey, this usually means that when a competition is occurring, classes rarely take place. The timeframe that the treatment took place during also happened to fall in the middle of basketball season and towards the main FFA competitions. These things did not affect the junior high kids and lower grade high school kids which I believe contributed to the upper level high school students' loss of interest and not finishing the treatment.

Effect on the Teacher

As the treatment progress, I saw very little change in my teaching habits. The way that I implemented the gaming principles allowed me to continue teaching the information as I had normally done in the past. The one area there was a major impact on was the planning phase of my teaching. The way that I implemented the gaming principles, as well as the Class Craft program itself, required me to do a lot more

planning to relate any side quests back to the lessons at hand. I also found myself setting a lot more time aside for grading to keep up with the changes that needed to occur with the players' avatars.

Conclusion

Based on the data gathered, there are a couple of conclusions that I can draw that help to answer my focus question. For one, there can be no discernable conclusion on to what affect gamification has on the retention of the material for a student. While there was an increase in test scores for one of the classes involved, there was a decrease in test scores in the other two. As mentioned earlier, this could have been influenced by the difficulty level of the material covered from class to class. This could have also been influenced by the academic level of the students involved in the classes.

Based on the data, it can also be concluded that gamification has a positive effect on a students' attitude towards science class as there was a slight increase in the values for both attitude and motivation to come to class. The slight change in the number of students that only slightly enjoyed the class after the changes were made can be attributed to the general feeling that every student gets as the school year progresses.

Another piece of evidence that leads to my conclusion is that while both groups (middle and high school) showed initial excitement over the treatment, it was the middle school and lower high school class that maintained this excitement throughout the treatment. As stated earlier, I attribute this to the discontinuity of schedules that is common in small schools were everyone seems to be involved in extracurricular activities. If this was done at the beginning of the school year or used sparingly

throughout, that could compensate for the discontinuity that I experienced. Making the experience more optional to students could also have an effect.

Based on these statements, it is reasonable to conclude that gamification can influence a student's attitude towards science classes and seems to have a greater impact on a middle school science class than a high school science class. From the data gathered, it is also safe to conclude that for gamification to work, there needs to be a more in-depth implementation of the principles and they need to be implemented earlier in the year. This could not only help avoid the pitfalls of scheduling that I ran into with my own research project, but also start the students out with topics that you would normally start a school year out with and the gaming can grow as you progress through the curriculum with your students.

VALUE

The goal of this project was to see what effect incorporating gamification principles has on both a high school and middle school setting. There are a couple outcomes that arose from this project. The first outcome is that the students became exposed to a learning style that they may have never seen before in a science classroom setting. Gamification has the potential to hit on all the various learning styles out there. It may also lessen the burden that a lot of students feel when they lose points on an assignment or test. Programs like Class Craft can allow students to receive some partial XP points for assignments they may not have done that great on. This might still give the student a sense of accomplishment, because as any gamer will tell you, leveling up is one great satisfaction for a game.

The second outcome affects me and my teaching abilities. I am always trying to find a way to enhance the way my students learn the material. I have become accustomed to using Power Point or notes on the board to help convey the material, but this has the potential to seem like I am in a rut. Gamification offers another way to convey the information from lessons to my students. By giving students optional objectives to meet in side quests, I can reach those students that are ahead of their classmates, while also not losing those students who tend to struggle.

Moving Forward

My current plan has been to use gamification principles in conjunction with what I am currently doing in middle school. There a few areas where I think this concept can move forward in. Instead of using this in conjunction with how classes are usually run, this could be done in place of the norm entirely. Instead of teaching a chapter the way that I have always done so (lecture/lab/review/assess), students are given the overall mission that must be accomplished and then a series of tasks that will build up to the conclusion of that mission, much like what happens during a regular video game. Another area that I think this concept could explore is how students would respond to where their grades are determined not by the score obtained on an assignment or test, but by how much XP they have achieved. The better a student does on an assignment, the more XP he/she can earn. Failing an assignment could result in gaining no XP or even losing XP, much like what would happen in a video game if you fail a mission.

There are aspects of gamification that were used in this study that can be replicated in the future. The use of powers and abilities gave the students an element of

control that they might not get from the normal class routine. The power to skip over an assignment would have to change, as I believe it made the students more complacent and more prone to "abuse" the power as some started to do in this study. Based on the conclusions discussed above, any future use of gamification would be focused primarily on the middle school classes initially. As these students continued, the option of using gamification could be given to the students as they progress through their high school careers.

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APPENDICES

APPENDIX A

ATTITUDE TOWARDS SCIENCE AND TECHNOLOGY PRETREATMENT SURVEY

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. With 10 being the highest, on a scale of 1-10, how much do you enjoy coming to science classes?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way that you did in the above question?

2. On a scale of 1-10, with 10 being highly motivated, how motivated are you to perform well in science classes?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way that you did in the above question?

3. How well do you enjoy the current set up of science class?
   Don't Enjoy Slightly Enjoy Enjoy Highly Enjoy

4. With 10 being an expert and 1 being a novice, rate your experience with technology.
   1 2 3 4 5 6 7 8 9 10

5. I feel that technology can improve my attitude towards coming to class.
   1 2 3 4 5 6 7 8 9 10
   No Improvement Great Improvement
   Why did you answer the way you did in the question above?

6. On a scale of 1-10, how much do you think a technology centered class will increase your appreciation for science class.
   1 2 3 4 5 6 7 8 9 10
   No Impact Great Impact
   Why did you answer the way that you did in the above question?

7. With 10 being an expert and 1 being a novice, rate your experience with video games:
   1 2 3 4 5 6 7 8 9 10

8. On a scale of 1-10, how much do you think would you enjoy a class that is set up like a video game?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way you did in the above question?

APPENDIX B

ATTITUDE TOWARDS GAMIFICATION POST-TREATMENT SURVEY

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. With 10 being the highest, on a scale of 1-10, how much did you enjoy coming to class once we started using Class Craft?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way that you did in the above question?

2. Rate, on a scale of 1-10 with 1 being no change, how much do you think your motivation to come to class change once we started using Class Craft?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way that you did in the above question?

3. How well have you enjoy the changes to science class?
   Don't Enjoy Slightly Enjoy Enjoy Highly Enjoy

4. On a scale of 1-10, how much have you enjoyed a class that included gamification principles?
   1 2 3 4 5 6 7 8 9 10
   Why did you answer the way you did in the above question?

5. Would you enjoy a class that used gamification principles more in depth in the future? Y N

APPENDIX C

PRE-TREATMENT INTERVIEW QUESTIONS

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. Do you find science interesting?

2. What activities or aspects of class do you enjoy?

3. Do you feel like you are learning in science class?

4. Have you heard of gamification before?

5. What has been your exposure to gaming in the past?

6. Would you be interested in a class that was set up to incorporate gaming aspects, such as leveling up, experience points, quests, and badges? Why or why not?

APPENDIX D

POST-TREATMENT INTERVIEW QUESTIONS

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. What aspects of the gamification process did you enjoy? What aspects did you not enjoy?

2. What are some things you would have changed about the process?

3. Do you feel like gamification helped you in class?

4. After your exposure to gamification, how interested would you be in a class that was set up exactly like a role-playing game like Class Craft?

APPENDIX E

EXCERPTS FROM TEACHER REFLECTIVE JOURNAL

Jan. 13th, 2017 – Introduced AR project to students. Interest seems high and kids are excited.

Jan. 20th, 2017 – All students have created their avatars and some are already asking how to get gold pieces to upgrade their character. A couple of students have opted out of the treatment not surprisingly.

Jan. 27th, 2017 – Most classes have logged in frequently in the first couple of weeks. Couple of classes have not.

Feb. 6th, 2017 – Most kids are gone for FFA so no quests for today. Those that are here are a bit bummed but it's something that might become more frequent with districts coming up.

Feb. 10th, 2017 – Some people have not logged in for a while. Wonder if something is up? On a positive note, the first review test using Class Craft's boss battle option worked wonders with the 8th graders.

Mar. 1st, 2017 – Most junior high students have logged in daily and have pretty much gained all their avatars armor. Treatment has been abandoned for sophomores and chemistry class as they seem the most uninterested and have rarely logged in. Basketball schedule may have been a factor. Really struggling with keeping up on side quests related to the topics at hand.

Mar. 10th, 2017 – I think we have hit the high point in the experience with some of them. Some of the 8th graders have commented that they don't really care anymore since they have all their characters' armor. Student A has not had a missing grade since February 10th. Third chapter review assignment that students have used powers to not skip…kind of frustrating but it's their choice.

Mar. 16th, 2017 – End of quarter is next week, so I informed the students we will no longer be using Class Craft once the quarter is over. Some are bummed but I think mainly it is because they must do chapter reviews now. Might have to forego chapter reviews in the future.

Mar. 21st, 2017 – Last day using Class Craft…don't know if I am relieved or not.

APPENDIX F

INSTITUTIONAL REVIEW BOARD EXEMPTION LETTER

MONTANA
STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

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MEMORANDUM

TO: Joseph DayRider and Walter Woolbaugh

FROM: Mark Quinn *Mark Quinn CJ*

DATE: November 28, 2016

SUBJECT: "*The Effect of Implementing Gamification Principles on a Middle and High School Science Classroom*" [JD112816-EX]

The above research, described in your submission of November 28, 2016, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

__X__ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

__X__ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

____ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

____ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

____ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

____ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.