

THE EFFECTS OF GAMIFICATION IN THE MIDDLE SCHOOL CLASSROOM

by

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ABSTRACT

Gamification, or the use of game elements in non-game contexts, has gained popularity in recent years as a way to increase engagement and motivation in various settings, including education. The aim of this paper is to explore the effects of gamification in the classroom. Specifically, literature on the use of gamification in educational settings will be reviewed, examining its impact on student motivation, learning outcomes, and attitudes towards learning. The potential drawbacks and challenges of implementing gamification strategies in the classroom will be discussed. I will detail the results of gamification in my own classroom and discuss its impact on the aforementioned topics. In my study, game elements included using character representations for each student, experience points and levels in place of traditional points and grades, and boss battles in place of tests. My analysis suggests that gamification can be an effective tool for enhancing student motivation and engagement in the classroom, leading to improved learning outcomes. However, the success of gamification strategies may depend on a number of factors, including the specific implementation, target audience, and context in which they are used. I conclude with gamification being an overall viable option for use in my own classroom.

CHAPTER ONE

INTRODUCTION & BACKGROUND

Context of Study

In Rigby, Idaho the average 6th grade science classroom at Farnsworth Middle School has between 22 and 30 students. Farnsworth has a total of 568 students. Of those students, 49% of them are female and 51% are males. The student to teacher ratio is 18:1. At Farnsworth Middle School 85% of students are white, 13% of students are Hispanic, and 2% of students are two or more races. About 24% of students are eligible for free or reduced lunch (Public School Review, 2022).

Over the four years I have been teaching 6th grade science, the consistent problem I have found with students is a lack of motivation to complete work independently. This problem has presented itself when students refuse to search for answers on their own and expect me to guide them to the answer, minimizing their effort in learning, regardless of ability. In my personal experience, lack of motivation also affects student participation in scientific discussion and student achievement in the classroom. I feel that this lack of motivation results, at least partially, from low levels of student engagement. Through this study I hoped to increase student engagement in the material and therefore increase student achievement. Up to this point in my teaching experience, student engagement has only been high on days when an exciting lab is performed.

I have spent time discussing engagement with other science teachers and we have brainstormed about what can be done to improve student engagement in the course material. The

most common response I have heard in these conversations is to make the material relevant to students' lives. The second response, often partially in jest and partially serious, is to use extrinsic motivation. Extrinsic motivation can be defined as any outside force that changes or motivates a student's behavior (Hanus & Fox, 2015). Extrinsic motivation of some kind is employed in most of the classrooms at Farnsworth Middle School, such as classroom parties and gotcha tickets which can be redeemed for little treats or toys. I have tried many of them but had not yet found one that fully aligns with my method of teaching. Initially, I decided I would relate lessons to common events in student lives in an attempt to increase student engagement. I tried to the best of my abilities to relate the course material to the students with some success. I saw more engagement in the lessons from a majority of students.

The amount of engagement I was able to get from that partial success is small in comparison to the engagement students have with their phones and video games. Each year most students spend significant amounts of time engaged with various video and online games. As technology continues to improve and becomes more integrated into society the interest level in gaming also seems to increase. As I have spoken with students, I have come to find that most of them have at least one type of digital game they periodically play. Others have said they have many games that they play often.

When preparing for my project, I was inspired to use the natural engagement of video games in the classroom. This method is referred to as gamification. I enjoy playing video games and am motivated to create a well-rounded gamified experience. Gamification in the classroom applies extrinsic motivation in a way that I am comfortable with while still allowing for intrinsic

motivation in student learning. My hypothesis is that gamification applied, in the right manner, will result in higher levels of engagement and therefore achievement in the classroom.

Focus Question

The focus of this study is to determine the effects of gamification on the middle school science classroom. The focus question was, How does gamification affect the middle school science classroom?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Gamification Introduction

A method to increase engagement in the classroom that has been gaining popularity is to gamify the classroom. Gamification has been defined as the use of game elements in a non-game context. The definition indicates that gamification can be applied to a wide range of activities that are not traditionally games (Hanus & Fox, 2015). Places where gamification has been used include various ad campaigns such as Nike, corporate offices, apps, retail stores, restaurants, and schools. In each category, the purpose has been to take something normally mundane and change it into something more exciting (Kim, 2015). Gamification being applied to the classroom is an idea that has been around for twenty to thirty years. The heart of gamification is adding elements of games or game mechanics to everyday learning in the classroom, like changing traditional points in the classroom to experience points (Brull & Finlayson, 2016).

It is not important to make your classroom exactly like a game or even focus on the playing part of a game, but rather it is more important to focus on specific elements found within games. The elements to focus on should be the ones that make games appealing to students and make them want to continue playing such as rewards, challenges, and levels. Pulling in a few of these elements in your classroom while simultaneously using a popular theme, such as world of warcraft, familiar to the teacher will result in a more engaging classroom. A popular theme is one that should be known to both the students and the teacher. The theme being familiar to the

teacher will help the teacher express excitement when introducing and carrying out the gamification, which will help students get excited as well. (Sheldon, 2020). Gamification ties an emotional response to whatever the students are learning with a higher level of engagement, which supports a higher retention of material. If set up correctly, a gamified classroom can meet each student at their academic level. Gamification is intended to be a platform that allows students to achieve their learning at their own controlled pace with immediate feedback (Brull & Finlayson, 2016). Gamification's ability to engage students is based off the success of game designers in capturing the attention of a large percentage of the population using game mechanics. By the end of 2013, it was estimated that 1.2 billion people would be playing some form of games (Kim, 2015). At the end of 2021 there were 3.2 billion gamers around the world (Clements, 2021).

Advantages in the Classroom

It is theorized that gamification works through self-determination. Self-determination gives students the ability to be autonomous with their learning, competence, and how well it relates to them. The ability to have more control over their learning gives students a greater desire to be engaged in the material. Gamification is designed to reach students both intrinsically and extrinsically, resulting in more engagement from a wider variety of students. Extrinsic motivation comes from the rewards built into the gamified classroom such as badges or powers. The intrinsic motivation comes from the student's ability to choose how fast they accomplish tasks and track their learning. There is also a benefit for the student as they are allowed to fail in an environment where there is no pressure of judgment from peers (Brull & Finlayson, 2016).

The teacher also has a variety of options to adapt gamification to their liking to match their teaching style. There are many different themes in gaming that relate to many different personalities. The teacher can choose from among a variety of themes, one that best fits their interests without having to limit what game mechanics they use in their classroom. Some teachers have modeled their gamified classroom after a game more like World of Warcraft while others have modeled their classrooms after more modern games (Sheldon, 2020). Students' freedom of choice and pace allows students to be individually scaffolded based solely on their abilities and not the abilities of the average. Both enrichment and intervention can be naturally incorporated into the classroom (Hanus & Fox, 2015).

Game Mechanics

To make gamification effective it is important to apply the game mechanics in the proper method to increase student engagement more effectively. A list of common game elements used in the classroom includes badges, points, leaderboards, challenges, rewards, and levels. Badges are various insignia awarded to students as they accomplish specific tasks. Points or experience are the same as awarding points in a traditional format. Leaderboards are a display of which players have the highest awarded points in a game. Challenges can be any task given to students to accomplish. Rewards are an in-game mechanic that is given out for accomplishing a variety of tasks or accomplishments. Levels indicate a player's accumulated points; players go up levels as they get more and more points (Brull & Finlayson, 2016). A more thorough categorization of game elements can be made by sorting them into three categories. Those three categories, in which game elements fall, are behavioral, progression, and feedback. The three categories are derived as a simpler version of the four basic elements at the core of regular gaming, which are a

goal, feedback system, rules, and voluntary participation. There are many types of elements, within those three larger categories of game elements. Stories/narrative, sorting, matching, replayability, matching and sorting, experiencing the concept, experiencing consequences, software challenges, practice, social simulator, immersion, and providing success are just a few of the types of game elements that can be included in a gamified classroom (Kim, 2015). Which game mechanics to include in the classroom will vary from classroom to classroom depending on both the students and the teacher (Sheldon, 2020).

Results of Gamified Classrooms

In the short time gamification has been studied and tried in the classroom, there have been varied results in effectiveness. In many studies engagement is shown to be increased, but in a part of those studies the higher engagement did not lead to better test scores. In fact, in some studies, the students scored lower on tests. One problem many studies have had when measuring the effectiveness of gamification is a lack of comparing a gamified classroom to a non-gamified classroom during the same time. Some studies have found that student's higher engagement levels decrease over time and their potential to develop an intrinsic motivation can be lowered due to gamification (Hanus & Fox, 2015).

A meta-analysis of 128 case studies confirmed the decrease in developing intrinsic motivation when extrinsic motivations are first used. The decrease in intrinsic motivation can be avoided if the goal of the gamified classroom is closely related to the goal of the player. In instances where the players are already intrinsically motivated at some level to perform the activities, their likelihood for a decrease in motivation is significantly lower. It is difficult to align the goal of the gamified classroom with the already established motivation of the students

because despite the game designer's best efforts the intended motivation doesn't always turn out to be the actual motivation felt by the students (Kim, 2015). There are other studies that provide a more promising outlook on gamified classrooms. A company called Rezzly has had tremendous results, showing that with a game-based approach ninety-three percent of students earned an A. They also reported students completing twice the material in less than half the time (Sheldon, 2020).

CHAPTER THREE

METHODOLOGY

Treatment

At Farnsworth Middle School in the 2022-2023 school year, of the sixty-seven sixth-grade students taught, ten percent of students were either on an Individualized Education Plan, Language Education Plan, or behavioral plan. The school is considered a Title One school, which means it has a high population of students who qualify for free or reduced breakfast and lunch due to low family income. Twenty percent of the sixty-seven students come from a farming background. Rigby is a small town with a population of about five thousand. The sixty-seven students comprised three different classes that all received the treatment. Of the sixty-seven students, fifty-three of those students are considered Caucasian, eleven students are considered Hispanic, and three of those students are considered Asian (Public School Review, 2022). The research methodology for this project received an exception by Montana State University's Institutional Review Board and compliance for work with human subjects was maintained (Appendix A).

The students were introduced to gamification in the classroom after the first unit of the trimester. Students were first asked to complete a survey measuring their attitude toward science, specifically if they enjoyed science and how much desire they had to do science. A syllabus (Appendix B) was given out with the details of the remainder of the trimester. The syllabus described how the class would be run like a game, gave details of their role in it, and what they could expect. They were to reach level 9 to pass the class and level seventeen to reach one

hundred percent in the class. They were told the assignments they completed in class would gain them experience points towards leveling up, and the tests they would complete would be bosses they needed to defeat. They were also introduced to potion tokens they would receive that could be redeemed for potion token rewards (Appendix C).

Students began the unit by making their own avatars. Each student was given the option to either come up with a name or to come up with a name and also create an image to represent their avatar. Avatars were done on paper and displayed throughout the trimester. The entire class was asked to come up with a name for their class alliance and invited to add artwork to their alliance board throughout the trimester. For the rest of the trimester, some normal academic words were replaced with other words; class became alliance, table group became guild, test became boss, points became experience points, passing the test became defeating the boss, and grade became level. I created my own avatar named Cognelius and gave the classroom the name Cognolia, or knowledge keeper and land of knowledge. After I received the avatars from the students, I displayed two random avatars from the three classes on the board each day to allow students to see what avatars other students came up with (Figure 1).

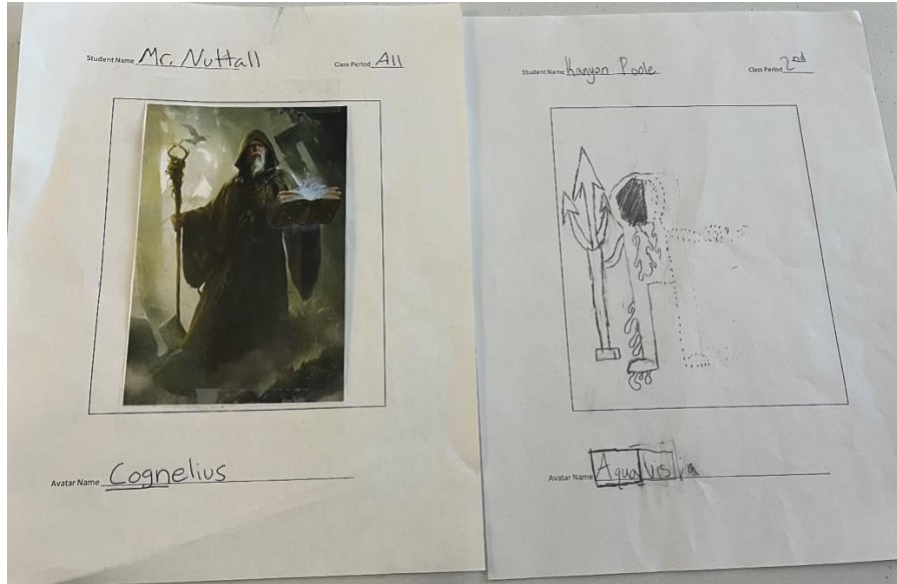


Figure 1. My teacher avatar on the left and a student generated avatar on the right.

During the first gamified unit, the students were given a formative assessment to measure how well they were understanding the material. Students were asked to describe in one paragraph what they understood about light and were asked to only include the most important things. They were also asked to write down anything they were confused about. A few days later the students were introduced to their first boss battle. The boss battle was designed to be pass/fail. On a traditional grading scale, students needed to score an equivalent to a B to beat the boss. If students did not beat the boss, they would be invited to do some extra studying and try again before school or during extra work time. Those who beat the boss on the first try were awarded bonus experience points. Later in the trimester a second boss for the thermal unit followed the same format. At the end of the trimester, students were asked to volunteer some time to answer interview questions.

Instruments

To gather data on students' interest and level of engagement in science, students were asked to complete the Science Attitude Survey at the start and end of the trimester (Appendix D). In this survey, students were asked how much they enjoy science as well as how much they liked to perform science, without the need of outside motivation. I created this survey by making an adaptation to the Test of Science Related Attitudes (TOSRA, 1981). I choose a selection of questions that pertained to the two attitudes previously described. The survey used questions that had a positive form and a negative form, meaning wherein the positive form *strongly agree* would indicate a positive attitude towards science and in the negative form, a *strongly agree* would indicate a negative attitude towards science. The responses were scaled as follows: a 1 signified *strongly disagree* in positive questions and *strongly agree* in negative questions, a 2 signified *disagree* in positive questions and *agree* in negative questions, a 3 signified *agree* in positive questions and *disagree* in negative questions, and a 4 signified a *strongly agree* in positive questions and a *strongly disagree* in negative questions. I averaged the scores of all three class's surveys from before the gamification treatment began and after the gamification treatment ended. The averages before and after indicated a positive or negative change in attitudes toward science. Normalized gain was calculated to determine the differences in student attitude. Normalized gain of less than 0.3 percent were considered low, gains 0.3 to 0.7 were considered a medium gain and normalized gains greater than 0.7 were considered high (Hake, 1998).

To gather data on how much learning students were achieving in the classroom midway through the gamified curriculum, I gave the students the Light Unit Comprehension Assessment (Appendix E). The formative assessment had students write about what they understood about

light and how we interact with it. They were also asked to identify what they were most confused about. I was able to use the data to gauge student learning in the classroom by comparing what they should know about light, to what they knew, and what they were confused about. I scored their responses on a scale of 0 to 4, where 0 indicated they showed no knowledge of the subject and 4 indicated they included all expected information. Using the mean of the scores, I determined if the class was learning what they needed to.

To gather data on student achievement overall, I gave the students the Post Thermal Unit Test (Appendix F). Students were directed to come up with a solution to people getting cold at night when they must sleep on the ground due to an emergency. The students were given typical conditions of the environment, criteria, and constraints to follow. Students were to design their solution using a specific spending budget, mock data collected on various supplies, and information about what is available to them. After designing a solution, the students were asked to defend and explain their decisions, using what they know about thermal energy and how it works. Students were scored based on their ability to present a solution that identified key components of thermal energy and how it works. There were a total of twelve possible points and nine were needed to defeat the boss. The Post Thermal Unit Test was given to two different groups of students. One group of students, which will be referred to as the Non-Gamified Class, were in the class last year and did not receive the treatment, while the other group of students, which will be referred to as the Gamified Class, were in class this year and received the treatment. How well the Gamified Class performed on this test was compared to the tests of the Non-Gamified Class from the previous year. The Non-Gamified Class were all scored with a

total of twelve possible points. To determine if there was any significant difference in test results a paired T-test was used.

To gather data on students' attitudes towards the gamification, I asked six students to participate in Post Trimester Interviews (Appendix G). Six students were chosen at random from those who volunteered to be a part of the interviews. Students were asked all the questions listed on Post Trimester Interviews as well as a few questions that were thought of during the interview. The questions were focused on how the students felt about the class being a game. They were asked what the best and worst parts were. Students were also asked if they felt the gamification helped them want to learn in the class. The answers were used to analyze the student perception of gamification and if it helped from their point of view. A close study of the transcript revealed four main topics that were focused on as important. The first topic showed that student created avatars and tests being labeled as bosses were an exciting and engaging part of the gamification. The second was that the potion token rewards were viewed as an integral part of the success of the gamified classroom. Third, any parts of the classroom that were non-interactive and long were viewed as boring and disengaging. Fourth, having game elements in the classroom was fun and would be something the students were excited to do again. The table shown below shows my research questions and the data collection methods just described (Table 1).

Table 1. Data Triangulation Matrix

	Data Collection Methods			
Research Question	Source 1	Source 2	Source 3	Source 4
Effects of gamification	Pre and Post Science Attitude Survey	Light Unit Comprehension Assessment	Post Thermal Unit Test	Post Trimester Interviews

CHAPTER FOUR

DATA ANALYSIS

Impact of Gamification on Student Academic Achievement

The Post Thermal Unit Test measured how well students understood the transfer of energy between particles, the behavior of particles in solids, liquids, and gases, and their ability to provide evidence and reasoning to explain their answers. The paired t-test showed the Gamified Class scored an average of 9.70 points out of 12 with a standard deviation of 1.36 ($n=46$). The Non-Gamified Class scored an average of 9.15 points out of 12 with a standard deviation of 1.81 ($n=46$). When the p-value of the Post Thermal Unit Test results were compared between the Gamified Class and Non-Gamified class, no statistical significance was found (Figure 2).

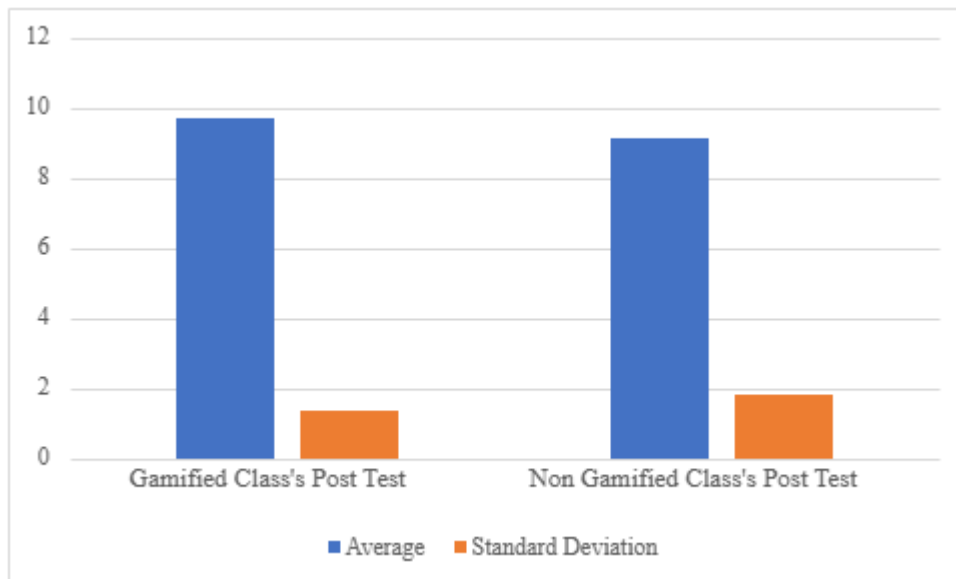


Figure 2. Post Thermal Unit Test average scores with standard deviation for both the Gamified Class, ($n=46$) and the Non-Gamified Class, ($n=46$).

Impact of Gamification on Student Science Attitude

To investigate if students' attitude toward science improved after gamification was applied, the Science Attitude Survey was used before the start of treatment and after the treatment. The survey focused on students' enjoyment of science as well as students' preference to perform experimental science rather than take the word of others. I took each response whether it was in the positive form or the negative form and ranked the responses from 1 to 4, with four representing a good attitude toward science. The first results show student responses before the treatment to questions pertaining to the enjoyment of science. When given the statement, "science lessons are fun," students' average response was 2.79 ($n=52$). When given the statement, "I dislike science lessons," students' average response scored a 2.71. When given the statement, "School should have more science lessons each week," students' average response scored a 2.27. When given the statement "Science lessons bore me," students' average response scored a 2.63. When given the statement "Science is one of the most interesting school subjects," students' average response scored a 2.27 (Figure 3).

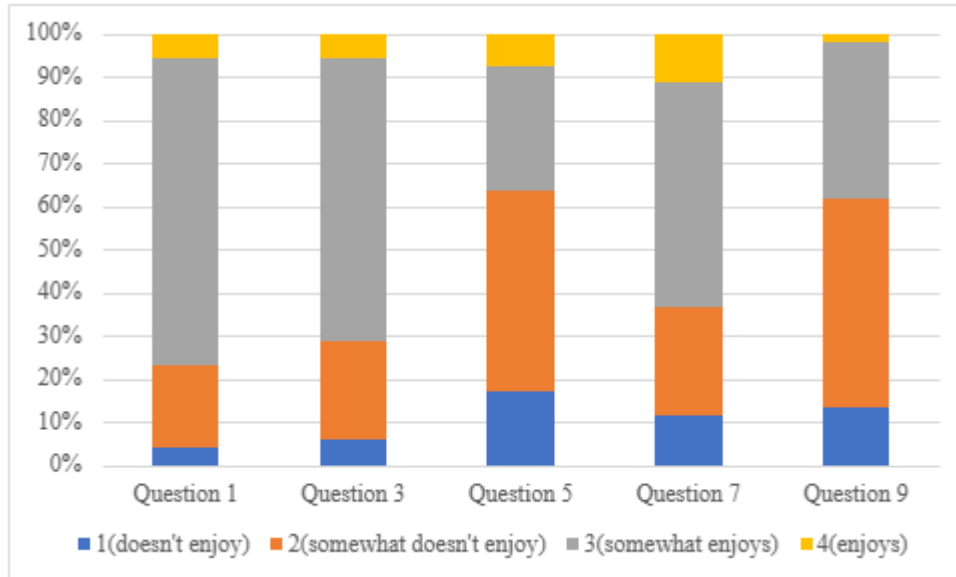


Figure 3. Science Attitude Survey (pre-treatment) responses to if students enjoy science, ($n=52$). The graph shows percentage of students who indicated they enjoy, somewhat enjoy, somewhat does not enjoy, or does not enjoy science before the treatment was applied. *Note.* Question 1: Science lessons are fun. Question 3: I dislike science lessons. Question 5: School should have more science lessons each week. Question 7: Science lessons bore me. Question 9: Science is one of the most interesting school subjects.

The second results show students' response after the treatment to the same questions.

When given the statement, "science lessons are fun," students average response scored a 2.58 ($n=52$). When given the statement, "I dislike science lessons," students' average response scored a 2.62. When given the statement, "School should have more science lessons each week," students' average response scored a 2.00. When given the statement "Science lessons bore me," students' average response scored a 2.40. When given the statement "Science is one of the most interesting school subjects," students' average response scored a 2.27 (Figure 4).

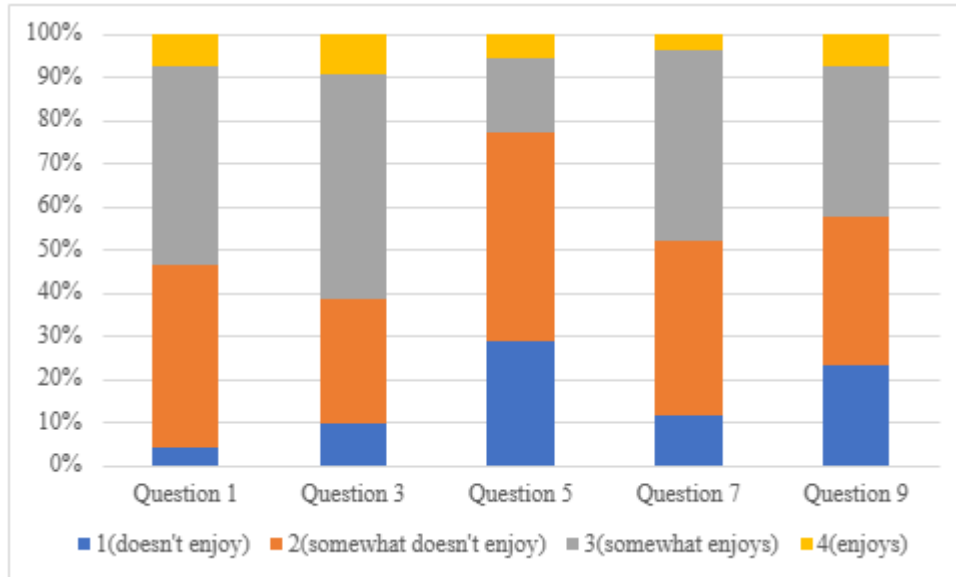


Figure 4. Science Attitude Survey (post-treatment) responses to if students enjoy science, ($n=52$). The graph shows percentage of students who indicated they enjoy, somewhat enjoy, somewhat does not enjoy, or does not enjoy science after the treatment was applied. *Note.* Question 1: Science lessons are fun. Question 3: I dislike science lessons. Question 5: School should have more science lessons each week. Question 7: Science lessons bore me. Question 9: Science is one of the most interesting school subjects.

Comparing the two charts reveals the percentage of students who indicated they somewhat enjoy science generally went down from pre-treatment to post-treatment while the number of students who indicated they somewhat do not enjoy science went up from pre-treatment to post-treatment. However, the percentage of students who indicated they enjoy science generally went up from pre-treatment to post-treatment while the number of students who don't enjoy science went down from pre-treatment to post-treatment. With both changes considered, the overall change was a small decrease.

The next results shown below measure the students' attitude towards performing science before the treatment. When given the statement, "I would prefer to find out why something happens by doing an experiment than by being told," students' average response scored a 3.35 ($n=52$). When given the statement, "Doing an experiment is not as helpful as finding out

information from teachers,” Students’ average response scored a 3.19. When given the statement, “I would prefer to do experiments than to read about them,” students’ average response scored a 3.63. When given the statement, “I would rather accept what people tell me than to do an experiment to find out for myself,” students’ average response scored a 3.38. When given the statement, “I would prefer to do my own experiments than to find out information from a teacher,” students’ average response scored a 2.94 (Figure 5).

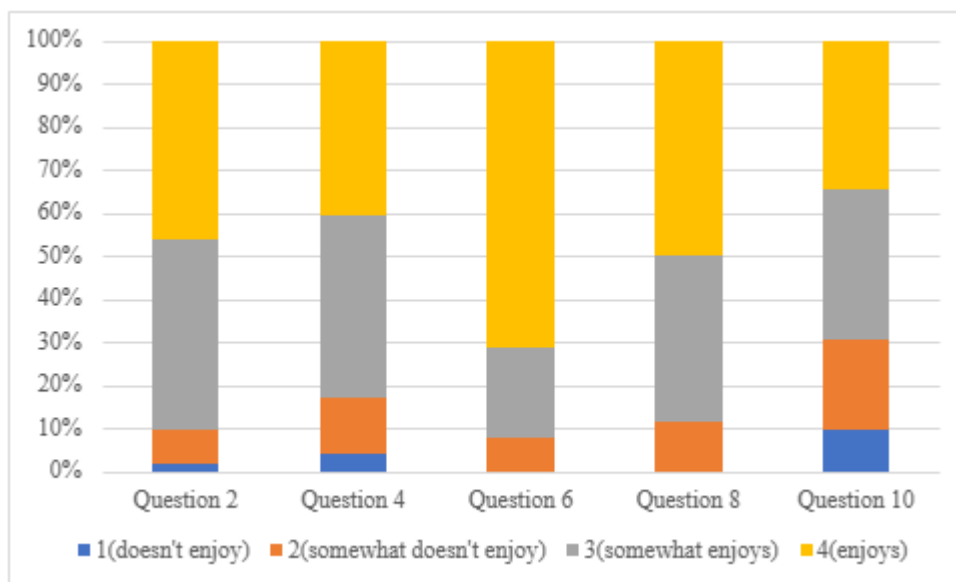


Figure 5. Science Attitude Survey (pre-treatment) responses to if students like performing science, ($n=52$). The graph shows percentage of students who indicated they enjoy, somewhat enjoy, somewhat does not enjoy, or does not enjoy science before the treatment was applied. *Note.* Question 2: I would prefer to find out why something happens by doing an experiment than by being told. Question 4: Doing an experiment is not as helpful as finding out information from teachers. Question 6: I would prefer to do experiments than to read about them. Question 8: I would rather accept what people tell me than to do an experiment to find out for myself. Question 10: I would prefer to do my own experiments than to find out information from a teacher.

The next survey results shown below measure the students’ attitude towards performing science after the treatment. When given the statement, “I would prefer to find out why something happens by doing an experiment than by being told,” students’ average response scored a 3.42

($n=52$). When given the statement, “Doing an experiment is not as helpful as finding out information from teachers,” Students’ average response scored a 3.15. When given the statement, “I would prefer to do experiments than to read about them,” students’ average response scored a 3.52. When given the statement, “I would rather accept what people tell me than to do an experiment to find out for myself,” students’ average response scored a 3.23. When given the statement, “I would prefer to do my own experiments than to find out information from a teacher,” students’ average response scored a 2.87 (Figure 6).

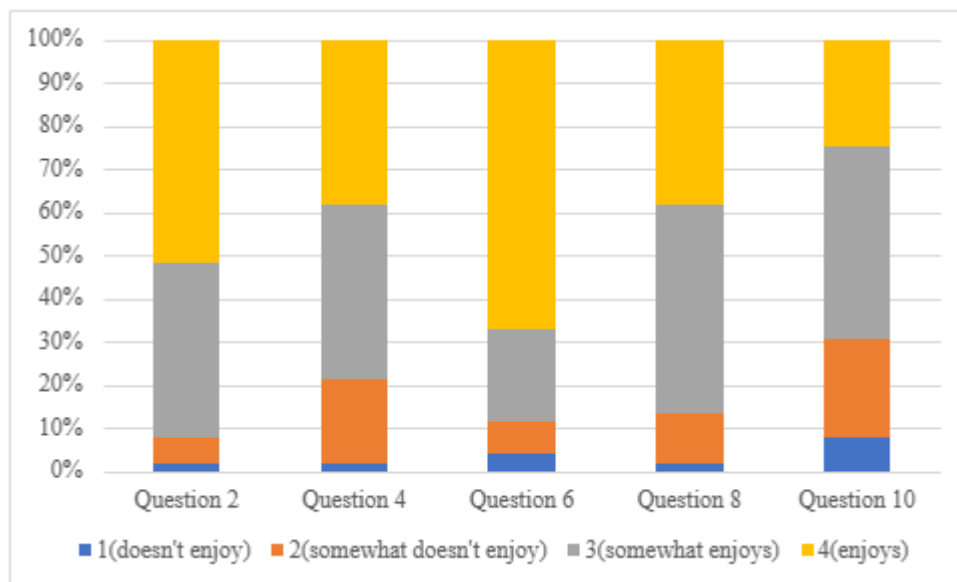


Figure 6. Science Attitude Survey (post-treatment) responses to if students like performing science, ($n=52$). The graph shows percentage of students who indicated they enjoy, somewhat enjoy, somewhat does not enjoy, or does not enjoy science after the treatment was applied. *Note.* Question 2: I would prefer to find out why something happens by doing an experiment than by being told. Question 4: Doing an experiment is not as helpful as finding out information from teachers. Question 6: I would prefer to do experiments than to read about them. Question 8: I would rather accept what people tell me than to do an experiment to find out for myself. Question 10: I would prefer to do my own experiments than to find out information from a teacher.

The results of the Science Attitude Survey indicated an overall average level of 2.53 out of 4 for enjoyment of science pre-treatment and an overall average level of 2.37 for enjoyment of

science post-treatment. The result for performing science indicated an overall average level of 3.3 pre-treatment and an overall average level of 3.24 post-treatment. The normalized gain change from pre-treatment to post-treatment for enjoyment of science was $-.16$, indicating no gain according to Hake (1988). The normalized gain from pre-treatment to post-treatment for performing science was $-.06$, also indicating no gain according to Hake (1988) (Figure 7).

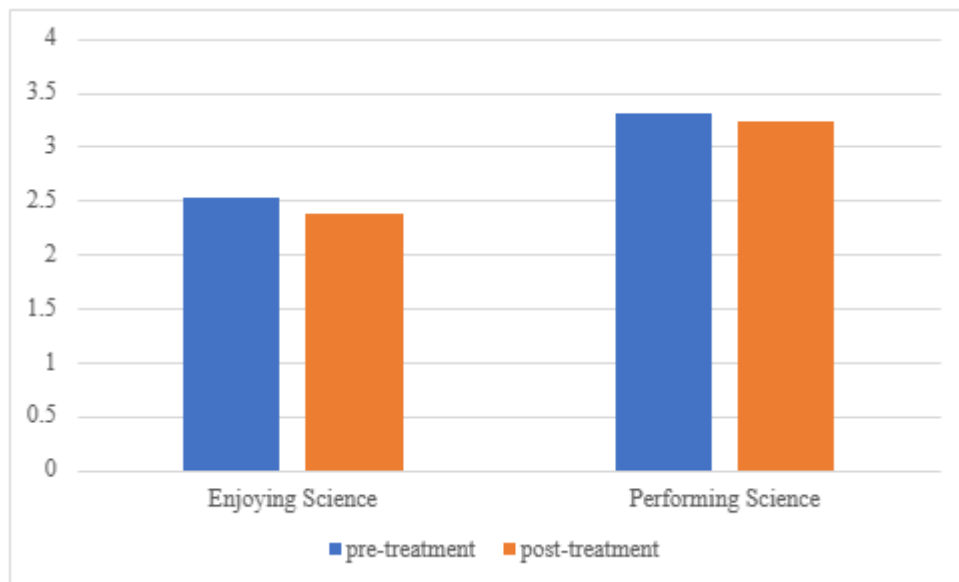


Figure 7. Science Attitude Survey overall averages of students' attitude towards enjoyment of science and performing science pre-treatment and post-treatment, ($n=52$).

Student Interest of Gamification in the Classroom

In the interview it became apparent that the tests being considered bosses stuck out to the students as something that contributed to their engagement in the gamified class. When asked, “What was the best part of the class?,” a student responded with, “The boss level” and other students agreed. When asked about the worst part of the class, the same student responded with, “The boss level. It was hard.” During the question about improving upon the game elements it was suggested, “We could make it so our avatars were actually fighting the boss.” Another

student built on with, “Yea and after we defeated the boss, we could pretend like we were going up to the boss and act out defeating him and then walking away.” The responses all indicate the students felt making the tests into bosses they battle and creating their own avatars were both an exciting part of the class.

Potion tokens as a reward was considered the best part of the gamified classroom. When asked what, “Was the best part of the class?,” there were many students who said the potion tokens. One student responded with, “When we do assignments, I like getting the grades, but it’s kind of like I did this project kind of for nothing, but when you get potion tokens as well it makes you feel like I want to do it now.” Other students expressed similar feelings. When asked if the game would have been as fun without the potion tokens the response was unanimously a no. The responses indicate the students enjoyed getting a reward for their work outside normal academic rewards of completing work.

When asked about the worst part of the gamified class multiple students agreed the long documentary was one of the worst parts. One student explained by saying, “they were interesting, but they were long.” Throughout the interview the students also expressed that some of the most fun they had was during experiments or hands on activities. One student said, “I also like when we do our own experiment” referring to times where the students plan and carry out their own investigations based on questions posed to them. The general feel of many of the responses indicated students prefer when they can do hands on, student-led learning.

When students were asked if they enjoyed game elements being in the class the answer was unanimously a yes. Students further expressed they preferred the game elements over the normal way class is conducted. One response to whether they would want to do it again was

“100% yes” to which everyone agreed. Students were excited for game elements as an addition to the classroom.

CHAPTER FIVE

CLAIM EVIDENCE & REASONING

Claims of the Study

The goal of this action research project was to determine the effects of gamification in the classroom. As a result of the study, the following claims can be made.

1. Gamification had no significant effect on student achievement.
2. Student enjoyment of science didn't change.
3. Students enjoyed the creativity and rewards gamification provided.

The first factor being considered is how gamification would affect students' academic achievement. The claim I have drawn from The Thermal Energy Post Test is gamification had no significant effect on academic achievement. I believe there was no affect because the gamification did not result in students engaging in learning the material any more than usual. Throughout the unit any additional excitement the students showed for the game elements were unrelated to the material itself. Since there was not an increase in excitement for the material, there wasn't an increase in engagement for the material, which in turn lead to higher academic achievement not being accomplished.

The second factor measured was how gamification would affect students' attitude towards science, specifically if they enjoy science as a class and if they like performing science. The TOSRA survey questions given to the students before and after treatment were based on these two attitudes. The claim I am making from this data is students did not show any increase or decrease in their enjoyment of science class or their attitude towards performing science. The

results of the TOSRA survey showed a normal gain of .26 towards enjoyment of science class and a normal gain of .49 towards performing science. Both are normal increases to be expected and did not indicate any significant change in their attitude toward science according to Hake (1988).

The third factor measured students' interest and enjoyment of game elements in the classroom. The post-treatment student interviews were the primary source of information. My claim is that students enjoyed the creativity and rewards provided by gamification in the classroom. Many students spoke positively about the game elements that existed, especially when it came to the rewards of the potion tokens. Most students expressed excitement over the prospect of continuing the gamification in the classroom and provided ways to build upon what was already there. I believe students love the chance to be creative and different through the avatars and boss battles, which contributed to their excitement. I also believe students are highly motivated by rewards and so were very excited by the potion tokens and what they were able to get through them.

Value of the Study and Consideration for Future Research

Using gamification in the classroom gave students a reason to be excited about things they are not normally excited about, like tests. Through the potion tokens, it also gave them motivation to complete in class work and assignments. Many students viewed it as worthwhile effort instead of simply forced effort. They liked being able to have options to use the potion tokens for things such as using the teacher's chair, getting to listen to music for the day, and an opportunity to have a class party twice each trimester. However, the motivation and excitement did not extend to other areas I was hoping it would help. Students did not view the gamification

as something that made science more fun than normal, but rather as something that made school more fun. It also did not lead to greater academic achievement as I hoped.

I believe it could be something worthwhile to continue to investigate despite it not helping in all of the areas I was hoping it would. From my conversation with the students the game elements could be worked on and increased in the future to make the experience fuller and more exciting. It is a lot of work to gamify the classroom and is something other studies have said takes time to do.

In the future, I would like to work towards creating a game experience where more of the learning is student-led achievement. I believe it is possible that the more student-led the gamified class becomes the more it will be able to influence students' overall attitude towards science. I would like to build off the student's idea to have avatars get closer and closer to the boss battles by having curriculum set up in a way that allows each student to progress towards learning goals at their own pace, with checkpoints along the way. Student progress in these goals can be monitored as was suggested by their avatars. I believe it is possible this would give the students a greater sense of accomplishment at the end.

Impact of Research on the Author

While analyzing the data, I realized that a lot of students did not have as high of an enjoyment of science as I would like. Thus, I have concluded that I need to reevaluate my efforts aimed at making science in my classroom more fun and enjoyable for the students. I still need the class to be academically rigorous, but I intend on looking into more ways I can bring greater student interaction to accomplish the rigor. I believe this can be done in a number of ways, including modifying the way gamification was done in the classroom as previously mentioned.

I also learned that my students can only do non-interactive things for so long before becoming bored and wanting to move on, even with things they find interesting. During student interviews most of the students expressed they became the most bored with things that had students either just watching or listening. In my future teaching, I intend to make lesson plans that limit the length of time students are doing non-interactive activities by incorporating more styles of teaching that gets the students moving and leading the learning, such as jigsaws, and stations for material that needs to be learned.

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APPENDICES

APPENDIX A

IRB APPROVAL FORM

From: NoReply@TOPAZTI.net <NoReply@TOPAZTI.net>

Date: Tuesday, December 13, 2022 at 1:54 PM

To: Graves, John

<graves@montana.edu>, jordanuttall0@gmail.com <jordanuttall0@gmail.com>,

Beiswanger, Kelly <kelly.beiswanger@montana.edu>

Subject: IRB Protocol #2022-503-EXEMPT APPROVED

****External Sender****

Hello Nuttall, Jordan,

Your protocol was reviewed by the IRB and has been approved.

PI: Nuttall, Jordan

Approval Date: 12/13/2022

Title: Gamification in the Classroom

Protocol #: 2022-503-EXEMPT

Review Type: Exempt Review

Expiration Date: 12/13/2027

APPENDIX B

SYLLABUS

Farnsworth Middle School
6th grade Science
Mr. Nuttall

Objectives:

- Increase knowledge of science and how to be a scientist
- Learn about light and how it interacts with us and our surroundings
- Learn more about thermal energy

Format

This class will be designed as a fantasy multiplayer game. All students will be the players of the game. Each player will create and use an avatar at the beginning of the trimester. Players will then be placed in guilds where they will strive to become the scientist with the most knowledge in the land. Throughout the trimesters students will face various tasks and challenges (quizzes, exams, investigations, etc.) that will help them become that scientist.

Grading Procedure

Throughout the course experience (xp) will be awarded for completing tasks and challenges. As you gain experience you will level up. Final Grades will be determined by what level has been reached at the end of the trimester. **You will need to reach level 9 to pass the class.**

For those who would like to have a general idea where your progress should be at throughout the year the following is a guideline of how much xp could be earned by the end of the indicated week:

Week 3: 80xp

Week 6: 340-390xp

Week 9: 540-590xp

Week 12: 800-900xp

Level	Level Title	Xp Needed	Rewards
1	Starving Neanderthal	20	1 potion token
2	Neanderthal	60	1 potion token
3	Observer	110	1 potion token
4	Tinkerer	170	1 potion tokens
5	Novice scientist	240	1 potion tokens
6	Astrologist	320	1 potion tokens
7	Laboratory technician	410	1 potion tokens
8	Alchemist	510	1 potion tokens
9	Scientist	630	1 potion tokens
10	Analyst	670	1 potion tokens
11	Research assistant	700	1 potion tokens
12	Researcher	730	1 potion tokens
13	Professor	770	1 potion tokens
14	Philosopher	800	1 potion tokens
15	Biologist	830	1 potion tokens
16	Physicist	870	1 potion tokens
17	Chemist	900	1 potion tokens

APPENDIX C

POTION TOKEN REWARDS

Potion Token Redemption

Food for the day	1 Token
Use the teachers chair	2 Tokens
Listen to music	2 Tokens
Get a Gotcha Ticket (redeem in counselor for candy)	2 Tokens
Use notes on a test	4 Tokens
Sit by a friend for the day	4 Tokens
Music for the day as a class	6 Tokens
Food Privileges for the class	8 Tokens
Guild Change (permanent seat change)	12 Tokens
Class Party (limit 2)	16 Tokens

APPENDIX D

SCIENCE ATTITUDE SURVEY

Science Attitude 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.

For each of the following questions please rate you each question either: strongly disagree, disagree, agree, or strongly agree by circling your option.

1. Science lessons are fun.
Strongly disagree disagree agree strongly agree
2. I would prefer to find out why something happens by doing an experiment than by being told.
Strongly disagree disagree agree strongly agree
3. I dislike science lessons.
Strongly disagree disagree agree strongly agree
4. Doing experiments is not as helpful as finding out information from teachers.
Strongly disagree disagree agree strongly agree
5. School should have more science lessons each week.
Strongly disagree disagree agree strongly agree
6. I would prefer to do experiments than to read about them.
Strongly disagree disagree agree strongly agree
7. Science lessons bore me.
Strongly disagree disagree agree strongly agree
8. I would rather accept what people tell me than to do an experiment to find out for myself.
Strongly disagree disagree agree strongly agree
9. Science is one of the most interesting school subjects.
Strongly disagree disagree agree strongly agree
10. I would prefer to do my own experiments than to find out information from a teacher.
Strongly disagree disagree agree strongly agree

APPENDIX E

LIGHT UNIT COMPREHENSION ASSESSMENT

1. In one paragraph or less describe what you understand about light, including how it works and how it interacts with us.
2. What is the thing you find the most confusing about light?

APPENDIX F

POST THERMAL UNIT TEST

Name: _____ Date: _____

Disaster Blanket Design Assessment

In emergencies, shelter or a place to sleep is very important. Often people spend nights outside on the ground. The government is trying to identify a solution that will keep people warm when they need to sleep directly on the ground. They are considering three different types of blankets and evaluating how well each of them will keep people warm. Below are their criteria and constraints.

Criteria:

1. Will keep people warm and alive sleeping outside for 6 hours at night, with no more than a 10 °F (5.5 degrees °C) temperature change in the air on the inside of the blanket where the person is.
2. Can also be used to keep people warm during the day.
3. Needs to be lightweight.

Constraints:

4. Keep cost low and affordable.
5. Environmentally friendly and can be reused.

			
Blanket type	U.S. Military disaster blanket	Emergency blanket	Fleece blanket
Material description	Double layer, dense wool	Single layer, thin mylar	Single layer, fleece
Color and texture	Grey, soft	Shiny on one side, smooth	Dark grey, soft
Weight	3 pounds (lb)	0.25 pounds (lb)	1 pound (lb)
Cost	\$15	\$3	\$15

Additional Data to Consider:

Average nightly conditions in September on the East Coast Average High: 84°F (29°C) Average Low: 64°F (18°C) Dry without rain	Human Body Temperature 98.6°F (37°C)
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Results of Initial Tests:

Blanket	Density Test (amount of matter)	Daytime core body temperature test (2 hours)	Nighttime core body temperature test (2 hours)	Environmental Impact Test
U.S. Military Wool Blanket	Double layer, thick, somewhat porous	Δ temp: -0.5 °C	Δ temp: -3.5 °C	Reusable, not washable
Emergency Blanket	Single layer, thin, not porous	Δ temp: -1.5°C	Δ temp: -2.8 °C	Reusable, then landfill
Black Fleece Blanket	Single layer, very porous	Δ temp: -2.5°C	Δ temp: -8.5 °C	Reusable, washable

1. Why is the government so concerned about people getting too cold if they sleep directly on the ground?

2. Use the information and data from the tests to make a recommendation for which blanket the government should choose. In your response include scientific reasoning to support your recommendation.

Choice: _____

Reasoning: Explain using scientific principles and connect the test results to the criteria and constraints.

3. In many environments, the temperature of the ground and the air right above the ground are both very similar in the middle of the night. Engineers have proposed developing a portable pop-up hammock that would allow people to sleep suspended in the air above the ground in emergencies. It will take time and money to develop a really lightweight, easy to collapse, low cost design. Before they invest the resources to do this, explain whether what you learned about energy transfer makes this an idea worth pursuing. Would suspending a person in a hammock, wrapped in one of the blankets you chose above, decrease the amount of temperature change compared to sleeping directly on the ground with one of these blankets? Explain.

APPENDIX G

POST TRIMESTER INTERVIEWS

Gamification Student Interviews

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. Overall, what did you think about the class being like a game?
2. Do you feel like the game made it easier for you to learn about science?
3. What was the best part about the class?
4. What was the worst part about the class?
5. Do you have any suggestions to make the class better?
6. Would you want to make the class like a game again?