Mathimagicians Quest: Applying game design concepts to education to increase school engagement for students with emotional and behavioral disabilities

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Abstract

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There are concerns among researchers and education professionals that students in our classrooms are bored, unmotivated and disengaged from school. There is substantial research showing low school engagement is linked to poorer school outcomes including: increased risk for drop-out, reduced academic performances and poorer well-being. Conversely, research indicates students with higher engagement have increased academic success, better well-being and higher rates of school completion. This link between school engagement and school outcomes is particularly concerning for students with disabilities who are at higher risks for low engagement, as compared with their general education peers. Though similarly cognitively challenging to school, games are typically highly engaging and students are willing to spend many hours engaged in playing games. Gamification has been proposed a means of applying game concepts to education in order to make school activities more engaging. This study explores the application of gamification to education, and the impact on student engagement. This study implements a gamification structure that can be applied across curriculum areas, which modifies student assessment and feedback using mechanics from role-play games. The gamified system was utilized in a

middle school classroom with students with Emotional/Behavior Disabilities in order to gamify math instruction over a two week unit. The study found no statistically significant results, but qualitative findings suggested that future research, with a larger sample and longer unit, into the impact of gamification on student engagement is warranted. Additionally, this study provides a template and direction for practitioners to consider if applying gamification in their classroom.

Introduction

Engagement and Student Outcomes

Current research in school engagement has largely centered on concerns from educational researchers and practitioners, that students are bored, unmotivated and disengaged in our classrooms (Upadyaya & Salmela-Aro, 2013). The literature indicates that student school engagement or disengagement can have a significant impact on student wellbeing, academic success, and risk for drop out (Archambault, Janosz, Morizot, & Pagani, 2009; Janosz, Archambault, Morizot, & Pagani, 2008; Lewis, Huebner, Malone, & Valois, 2011; Li & Lerner, 2011; Reschly, Huebner, Appleton, & Antaramian, 2008; Salmela-Aro & Upadyaya, 2014; Upadyaya & Salmela-Aro, 2013). This is particularly concerning in special education classrooms, where students are frequently behind academically compared with their general education peers, and are already significantly more at risk for negative school outcomes (Reschly & Christenson, 2006; Sinclair, Christenson, Evelo, & Hurley, 1998). Given the substantial impact of engagement on school outcomes it is imperative that teachers, and most especially special educators, strive to develop methods of increasing and sustaining student school engagement.

There is no single definition of school engagement in the literature; it is considered a multidimensional concept that is a product of the interaction between behavioral, cognitive, and affective components (Appleton, Christenson, & Furlong, 2008; Fredricks, Blumenfeld, & Paris, 2004; Upadyaya & Salmela-Aro, 2013). The behavioral components consider student's actions of involvement in school; such as presence or absence in class, academic work completion, and compliance with school expectations and discipline (Appleton et al., 2008; Fredricks et al., 2004; Upadyaya & Salmela-Aro, 2013). The cognitive

components of engagement speak to a student's investment and willingness to learn and put in effort, motivation to complete tasks and goals, and self-regulation skills (Appleton et al., 2008; Fredricks et al., 2004; Upadyaya & Salmela-Aro, 2013). Affective components encompass enjoyment and interest in school activities, feelings and reactions towards peers, teachers and the school overall. For the purposes of this research engagement is defined as the desire and motivation to participate in school and school related activities (Appleton et al., 2008; Fredricks et al., 2004; Upadyaya & Salmela-Aro, 2013).

There is extensive research indicating low levels or unstable student engagement is related to poorer student outcomes; these results are seen across behavioral, affective and cognitive measures of engagement (Archambault et al., 2009; Finn & Rock, 1997; Janosz et al., 2008; Li & Lerner, 2011; Reschly & Christenson, 2006; Upadyaya & Salmela-Aro, 2013). This negative impact of low student engagement can clearly be seen with drop-out rates, and risk for drop out. For the general student population, those who reported lower, decreasing, or unstable engagement in school were at a significantly increased risk for dropout (Archambault et al., 2009; Finn & Rock, 1997; Janosz et al., 2008). Archambault et al., (2009) surveyed 13,000 high school students on their engagement in school: including questions on their enjoyment and interest in school tasks, willingness to learn, attendance and school discipline. Their results showed students who rated their engagement in school as higher were more likely to complete school (Archambault et al., 2009). The negative impact of poor school engagement is particularly worrying for students' with learning disabilities (LD) or emotional behavioral disabilities (EBD) who are already at an increased risk for low school engagement compared with their general education peers (Reschly & Christenson, 2006). Reschly & Christenson, (2006) found in a study of 14,000 eight-grade

students that 26% of students with LD and 49.9% of students with EBD dropped out of school, as compared with only 14% of students without disabilities. Reduced academic success and poorer wellbeing has also been noted for students with low engagement. A study by Li & Lerner (2011) measured the behavioral and affective engagement of 1,900 fifth to eight grade students. Affective engagement was assessed by questionnaire, including questions such as how much students cared about school or felt school cared about them, behavioral engagement included data on student attendance and work completion. They found students with reduced affective engagement had lower grades, the effect was greater for those with decreasing engagement over time. Similarly, they found that students with lower behavioral engagement had higher levels of depression (Li & Lerner, 2011).

Many studies have taken the more positive perspective and found students with higher levels of affective, cognitive and behavioral engagement have shown significantly improved outcomes as compared with their less engaged peers (Dotterer & Lowe, 2011; Finn & Rock, 1997; Reschly & Christenson, 2006; Salmela-Aro & Upadyaya, 2014; Sinclair et al., 1998). Reschly & Christenson, (2006) followed 14,000 eight grade students and measured their school engagement including attendance, extracurricular participation and relationships with teachers. Behavioral engagement measures including misbehavior and preparation for class were found to be a significant predictors of school completion and drop out; higher engagement increased the likelihood of school completion in students with LD and EBD (Reschly & Christenson, 2006). Similarly, programs designed to increase engagement, have been shown to reduce risk for dropout and increase the likelihood of school completion through improving student school engagement. Sinclair et al., (1998)

compared a group of 94 students with EBD and/or LD, half of whom received an intervention designed on increase school engagement, and found the treatment group was more likely to be on track to graduate, 46% compared with 20% in the control group. Increased academic progress and achievement has been associated with higher overall engagement in a number of studies (Dotterer & Lowe, 2011; Finn & Rock, 1997; Upadyaya & Salmela-Aro, 2013). For instance, Finn & Rock (1997), studied the impact of engagement on academic achievement of 1,800 tenth through twelfth grade students. Teachers and students completed reports of student school engagement, including work completion, attention and participation in class, and school absences. They found increased academic success among students with higher engagement, even when controlling for environmental factors, such as race and socioeconomic status, which placed them as a greater risk of academic failure (Finn & Rock, 1997). Student wellbeing is also strongly affected by increased engagement; studies have found high levels of school engagement was associated with greater positive emotions, adaptive coping, and life satisfaction (Lewis et al., 2011; Reschly & Christenson, 2006). Lewis et al., (2011) surveyed 700 middle school students on their school engagement and life satisfaction, and found a significant positive relationship between life satisfaction and student school engagement. The effect of engagement on student well-being, has even been found to persist after school completion. Salmela-Aro & Upadyaya, (2014) followed 1,700 adolescents before, during, and after post-comprehensive education, and noted school engagement was positively related to life satisfaction two years post-comprehensive education.

Given the significance of student engagement on school outcomes, researchers and education professionals have developed and studied interventions designed to increase

student engagement (Balfanz, Herzog, & Mac Iver, 2007; Gonzales et al., 2014; Holt, Bry, & Johnson, 2008; Sinclair et al., 1998). The focus of many of those current interventions was how the use of mentoring and monitoring programs could foster student engagement, and ultimately reduce student drop-out and the increase student graduation rates (Balfanz et al., 2007; Gonzales et al., 2014; Holt et al., 2008; Sinclair et al., 1998). One particularly successful intervention is the Check and Connect program. In this program students with LD and EBD are assigned a mentor that monitors them (including grades, absences, behavior referrals), and then provides personalized interventions to help students solve problems, and build skills, while also serving as a liaison between home and school (Anderson, Christenson, Sinclair, & Lehr, 2004; Lehr, Sinclair, & Christenson, 2004; Sinclair et al., 1998). Check and Connect has been shown, in a study by Sinclair et al., (1998), to be effective at reducing student drop-out rates and increasing school engagement; students who received the intervention were more on track to graduate, continued to remain enrolled in school and more inclined to complete academic work, compared to those that did not receive the intervention. Though programs like Check and Connect have been successful at improving student outcomes and increasing engagement; there remains a need for interventions that can be implemented on smaller classroom scales and focus on other measures of engagement.

Games, Engagement, and Gamification

From video games to competitive sports, games are rarely simple and easy activities, rather they require players to invest significant amounts of time, and cognitive energy to successfully participate. Yet despite all this effort required of game players it is hard work they are willing to apply, the video game industry makes billions of dollars in

revenue each year, with the average gamer spending 8 hours a week playing games("Video Game Industry Statistics | Entertainment Software Rating Board," n.d.). This suggests there is something about games that makes them highly engaging. While school also requires students to undertake demanding challenges, many students remain unengaged in school and yet willing to invest significant amounts of time into games. Extensive thought has been put into understanding what keeps players gaming. This has prompted game designers and education professionals to consider the potential application of the elements that make games engaging, to the disengaging activities of school (Deterding, Dixon, Khaled, & Nacke, 2011; McGonigal, 2011; Sweetser & Wyeth, 2005).

To consider how games are engaging we must understand what a game is, and what game engagement looks like. For the purposes of this investigation the following definition was developed based on a synthesis of a wide swath of definitions and shared traits: *games are a system in which players voluntarily work towards an objective, constrained by rules, with consistent feedback on their progress* (McGonigal, 2011; Suits & Hurka, 2005; Tekinbas & Zimmerman, 2003). From this, the definition of school engagement can be modified to apply to games; as the desire and motivation to participate in the game system.

The prevailing theory explaining why games are engaging is they are designed to consistently and quickly stimulate a *flow* state. Csikszentmihalyi (1990), created the term flow to describe an experience "so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous" (p. 105). The flow state is one of total involvement and engrossment in an activity, in other words being completely engaged in what one is doing. While we see this complete involvement in an activity for those playing games, we do not frequently find

students in our classroom to be totally immersed in the usual classroom tasks being set; rather many are disengaged from normal school activities (Shernoff & Csikszentmihalyi, 2009). There is a broad variability in the types of activities that can stimulate a flow state, from reading to playing sports. They share, however, several fundamental elements: the activity must have a clear goal, limited stimulus field, allow for control over actions and the environment, provide immediate feedback, and have a balance between the perceived challenges and perceived skills (Csikszentmihalyi, 1990, 2000). Games by their definition have all of these qualities: an objective that delineates a specific outcome that the players want to achieve, players' regularly receive feedback on progress (or lack of progress) towards the objective, the rules limit the field of focus by providing restrictions on how the objective can be achieved, while the players voluntarily choose to participate in the game based on their perceived skills, all of which allow the player to control their actions and environments within the restrictions of the system (Csikszentmihalyi, 1990, 2000; Sweetser & Wyeth, 2005).

Games are in essence designed to create highly engaging flow states for their players, and as such have the ability to immerse players for extended periods of time in challenging and cognitively demanding activities (Csikszentmihalyi, 2000; McGonigal, 2011). School, in contrast, may often lack these elements, student may receive insufficient feedback, lack a clear objective, and often activities do not line up with their skills and needed challenge (Shernoff & Csikszentmihalyi, 2009). There has been a push from game designers and education practitioners to apply the elements that make games engaging, features that stimulate a flow state, to the non-game setting of education (Deterding et al., 2011; Gee, 2007; Shernoff & Csikszentmihalyi, 2009). In recent years there has been an

extensive increase in consumer software (e.g. web applications, apps, desktop programs) that takes inspiration from games in order to increase user engagement. Similar trends have been seen in education specific software, particularly professional industry (non-school) contexts (Deterding et al., 2011; Hamari, Koivisto, & Sarsa, 2014; McGonigal, 2011). This process of incorporating game elements into non-game settings and activities, has been described as gamification.

The concept of gamification is relatively new, and though somewhat contested among researchers and professionals, it remains one of best terms to use to describe the trend. For the purposes of this study gamification is defined as the application of game elements to non-game contexts (Deterding et al., 2011; McGonigal, 2011). This does not mean turning a non-game context directly into a game, but rather the inclusion of a selection of the elements that define a game (voluntary participation, rules, goals, and feedback) though the use of game mechanics, within a specified activity. Game mechanics are the method that game designers use to integrate the key elements of a game into the actual activity; providing the rules, feedback, and objective within the system. The concept of flow, and the elements that define a game, explain why games are engaging, while game mechanics determine how games are made engaging.

The language learning app Duolingo provides a good example of gamification applied to education. Users of Duolingo select the language they want to learn and then complete a series of lessons; users must complete the lessons for each level before being allowed to move on to the next level. Duolingo uses a number of different game mechanics to gamify language learning; in each lesson, users have 3 lives which they lose for incorrect responses, and losing all three will require them to repeat the lesson, at the end of each

lesson they earn experience points and increase levels. Users can also set goals for how often they complete lessons, and reach levels ("Duolingo | Learn Spanish, French, German, Portuguese, Italian and English for free," n.d.). Duolingo gamifies language learning through the incorporation of several game elements through game mechanics; users voluntarily choose to participate in the program, they have a clear objective of learning a language or reaching a level, and each lesson they immediately receive feedback on correct or incorrect responses. Duolingo provides a useful example of how a wide variety of game mechanics can be used to instill the elements of a game into non-game activities, in order to make them more engaging, and an effective learning tool.

Research into the application of gamification still remains a new field of study, with any significant amount of empirical research only having been conducted in the past 5 years. The studies that have been done show a wide variety of applications, contexts, and activities that have been gamified; and a still broader pool of game elements and mechanics that have been incorporated in order to gamify an activity (Hamari et al., 2014). Beyond this, there is little empirical research into gamification of education and learning; the majority of the current evidence is from university and professional non-school contexts, looking specifically at adult learners (Denny, 2013; Deterding et al., 2011; Domínguez et al., 2013; Hamari et al., 2014; Kapp, 2012). Of the few examples of research into the gamification of education, there is some promise of its effectiveness at increasing student engagement. For example, Denny (2013) examined a badge based achievement system, where students are given virtual badges for the completion of specified activities, within an online learning tool for university students. They found that students who participated in the badge-based system had increased participation in the course, including an increased

number of answers and days they were active in the system (Denny, 2013). Similarly, Domínguez et al. (2013) found students who used a similar badge-based system, reported positive feelings towards the system and increased motivation to participate in the course. While both studies looked at gamification of education, they relied heavily on similar mechanics of badges, points, achievements, and leader boards as methods of fostering student engagement. In education overall, the conversation about gamification still largely revolves around theory, positing that gamification in the classroom should be an effective tool for increasing student learning and engagement (Gee, 2007; Kapp, 2012).

Despite this lack of empirical research, a google search of 'gamification classroom' will direct you to a number of examples of teachers implementing gamification in their teaching, suggestions on how to gamify instruction and even programs to help teachers gamify ("Classcraft – Gamification," n.d., "Gamification | Mr. Gonzalez's Classroom," n.d., "Gamifying My Class | How I've Created My 'Game' Sites & Prepare My Classes For Their 'inStructural' Transformation = Altering the Structure of Instruction," n.d.). As teachers it is our responsibility to utilize evidenced based practices in order to most effectively educate our students. The reality is also that as practitioners in our classrooms we find the need to try new methods of instruction, especially when the current evidence based practices are not working as effectively to support our students' development and classroom engagement. As it stands gamification of education lacks significant empirical research in order to define it as an evidence based practice, and there is a need for further studies to determine the effectiveness of gamification for increasing student engagement.

Research Purpose

The objective of this research study was to explore the implementation of a gamified curriculum and report on its relationship to student school engagement. This study investigated the application of a gamified 7th grade mathematics curriculum in a self-contained school for students with Emotional and Behavioral Disabilities (EBD).

Students with EBD are at some of the highest risk for low school engagement, which in turn can lead to a number of poor school outcomes (Prevatt & Kelly, 2003; Reschly & Christenson, 2006). Gamification has the potential to increase student engagement in academics, through rendering classrooms activities into something closer to a flow experience (Csikszentmihalyi, 2000; Gee, 2007; McGonigal, 2011). This study will provided an example of gamification in an academic context, and provided teaching practitioners direction and a foundation for the incorporation of gamified instruction into their classrooms. The research question for the study were:

1. How does gamification of math instruction impact the school engagement of students?
2. How can practitioners approach the implantation of gamification in the classroom?

Design Principals

For this study a stand-alone gamification structure that can be applied across curriculum areas, was created. The gamified instruction was intended to not alter the curriculum presented to students, nor necessitate specific methods of teaching. Rather the system was designed to provide a structure that aligns with multiple teaching methodologies, and includes a modified structure of assessment, progress monitoring and student feedback. Furthermore, the gamified instruction system was intended to be

transferable to multiple classroom settings, and have low requirements for technology access in the classroom or at home. Overall I designed the gamification to be as simple as possible, while still including the necessary mechanics to incorporate the core elements of a game.

The game mechanics used in the design of the gamified system were pulled largely from a genre of games referred to as 'Role-Play Games'. In these games players take on a persona, which acts as their avatar (or representation of themselves) within the game system; these types of games frequently have a large overarching goal (often on an epic scale such as saving the world), and hit milestones of smaller goals on route. Additionally, as the player gains better skills, their avatar increases skills as well. These components align well with students' experiences in the classroom, and can allow for the application of the four core game elements into their school experience in a meaningful and engaging manner.

Game mechanics.

The following are the principal game mechanics that were used within the gamification instruction system. These terms were expected to be easily accessible and understandable by the students who participate in the gamified unit as they were already familiar with Role-Play Games and the genre specific terminology.

- *Avatar* – this is the visual and verbal representation of the player within the game, each participant created a unique image and name that was used on their character sheet.

- *Experience Points (XP)* – these are a numeric representation of the difficulty of a task and its completion. Harder academic tasks earn more XP, and students were able to earn a predetermined amount of XP each lesson.
- *Level* – the levels are bench marks that the students reached based on their current experience points, levels provided shorter term goals for the student to reach each lesson.
- *Character Sheet* – this is a page that contained the students' avatar (name and image), their current level, current experience points, the experience points needed to get to the next level, and all current skills they had mastered.
- *Boss Battle* – Boss Battles are summative assessments that were given after the completion of a specified number of lessons. Successful defeating of the boss represented mastery of the academic material. Completion of the assessment was rewarded with a determined amount of XP.
- *Missions* – academic classroom activities were referred to as missions. Each mission had a predetermined amount of XP that was rewarded for its completion. Each lesson was composed of a number of different missions.
- *Skills* – these are the mathematical skills the students learned during the unit, in essence the lesson objective. These were represented by stickers students received immediately after finishing a lesson, which would be placed on their character sheet.

Gamification structure.

The game mechanics that were used for the gamified instruction system were designed to incorporate the core elements of a game, while keeping the system as simple

and technology light as possible. The focus for the instruction unit was the inclusion of mechanics to provide consistent and rapid feedback as well as clear and defined goals. Mechanics were selected based on their incorporation of the core components of a flow state, and thus elements of games that would be more likely to increase student engagement (Csikszentmihalyi, 2000).

Voluntary participation and rules were built-in to an extent within the system, but the major focus on the selection of mechanics was in the feedback and goals. The gamified instruction did, to an extent, allow for voluntary participation. Students were not required to participate in the game unit and students that opted not to participate still had full access to math instruction but without the added game based elements. The notion of voluntary participation, however, was somewhat difficult to have in a school setting where attendance and academic tasks are obligatory. The rules of the gamified instruction system were primarily built into the requirements for students to level up, and the expectation that they would complete academic assignments in order to do this.

Specific goals and feedback on progress were incorporated into the instruction system through two primary mechanics. The first was ‘unlocking skills’, an achievement tied directly to the lesson objective, after which the students received a tangible reward in the form of a sticker to document their mastery of lesson content. To get the sticker and earn the skill students had to complete all lesson missions. This was a daily goal that they could use to document their progress in each lesson. The second mechanic is the level and XP system, students had the information of their current level, the amount of XP needed to reach the next level and the amount of XP they earned for each mission in the lesson. Students who did not complete a full lesson could still receive XP for the missions they

completed. Overall the levels and XP allowed the students to see exactly how far away they were from the goal of the next level, while also being able to clearly document the progress they were making toward it throughout the lesson. Additionally, students were given an updated character sheet each day, documenting the goals reached and the distance to the next goal, providing them quick feedback on their progress in the unit.

Methods

Three 7th grade male students, with Emotional/Behavioral Disabilities participated in the study. All students were part of a self-contained school program from students with Emotional and Behavioral Disabilities. The gamified instruction unit took place over ten 45 minute lessons, with one lesson per day. The entire unit lasted two school weeks. The curriculum used for the unit was the district 7th grade general education curriculum in the unit titled 'Number Systems'. The unit used the 'Accentuating the Negative' textbook (Investigations 3 and 4), and covered the following mathematical topics: fact families with positive and negative integers, coordinate graphing, multiplying and dividing positive and negative integers ("pearsonschool.com: Prentice Hall Connected Mathematics 2 (CMP2)," n.d.).

Before the first lessons students created an avatar, they were given the option of using a number of different avatar building websites or creating one by hand ("Create Your Own Superhero | Marvel.com," n.d., "Free Anime Avatar Maker - Avachara is a web app that can be creative cartoon character.," n.d.), they then provided a name for the character and the teacher used these to create the character sheet they would have for each lesson. The character sheet contained the student's avatar and name, their current XP, current level, the XP needed to reach the next level and skills they had unlocked from each lesson (Figure

1). This information was also tracked separately by me in a spreadsheet, which was updated after each lesson and transferred on to the character sheet.

Figure 1. Example of student character sheet.

During each lesson students were able to earn a set amount of XP, which was predetermined with an increasing amount of XP earned per lesson; as content became harder students were rewarded with more XP. The amount of XP was intended for students who fully participated in a lesson to level up roughly once per lesson. The content for each lesson was then broken down into a number of missions and additional activities that would earn specified amounts of XP, adding up to the total XP for each lesson. For example each lesson opened with a math warm up, had a closing exit ticket, and a portion of XP was always allotted for participation in the lesson. Appendix 1 identifies the total XP for each lesson, and the breakdown of XP for each lesson activity. In each class the breakdown of experience points for missions was posted on the white board, along with the learning

target and a lesson activity checklist. In addition, the XP for each activity was written on the worksheets for the lesson, as can be seen in Appendix 2.

At the end of each week, students were given a summative assessment (as one of the lessons), which tested them on the material they had learned. This assessment was presented as a boss battle, and identified a monster they had to defeat with discrete activities worth specific XP that they would need to complete (Appendix 2). The assessment also served to identify next steps for instruction, while allowing the students to demonstrate and receive feedback on their mastery of skills. After the completion of each lesson and boss battles students who participated were immediately given a sticker that indicated the skill they had 'unlocked' which was the learning target for the lesson. They could then put their stickers on their character sheet as an additional log of their progress, these stickers can be seen on the bottom portion of the character sheet in Figure1.

Measures

A number of different measures were used in order to capture a full picture of student cognitive, affective and behavioral engagement during and before the gamified instruction unit. As a school for students with EBD, regular behavior tracking is done across a number of different measures. The normally collected data was used as part of the study, with only one additional measure administered for the study.

The following measures were collected during the course of the two week unit, most of these were daily measures. They were also collected for the week prior to the start of the academic unit to provide a baseline for student engagement during normal class instruction.

- **Time in class** - recorded before and during the unit each day. The number of minutes the student was in the classroom is recorded (a maximum of 45 for each period). While this did not always indicate if a student is participating in the academic period, it can be an indicator of behavioral engagement, or a willingness to be in the academic environment.
- **Behavior points** - collected both before and during the unit. The school regularly tracks students on the following behavioral expectations in the classroom: complete task accurately and on time; follow directions; speak at the right time using school appropriate language and tone; keep hands feet and objects to self; stay in assigned area; use school property and materials appropriately. Students are scored on a 1 – 6 scale, 6 being above expectations, 5 meeting expectations with no reminders, 4 needing one to two reminders, 3 needing three to four reminder, 2 needing five or more reminders and the expectation is not met, 1 being unsafe behavior or no work produced. These expectations give a picture of student engagement and willingness to complete the academic task for the lesson, and compliance with school rules.
- **Grades and copies of classroom assignments** - these data showed both the academic engagement, and can also provide a picture of changes in mathematical understanding during the unit, or increases in work quality or production.
- **Field notes** - recorded only during the unit to note student comments and actions that were not otherwise captured in other data collection, with a

specific focus on academic understandings, behavior within the lesson and gamification specific comments or activities.

- **Student Engagement Instrument** (SEI; Appendix 3; Appleton, Christenson, Kim, & Reschly, 2006) - 35 item questionnaire that is used to measure student engagement in school and learning. The SEI provides a snapshot of student cognitive and affective engagement, and includes questions on student perceptions of the school, feelings towards school and family involvement. The SEI is a reliable measure and has been used across a number of studies on student engagement, and the measure has been generally correlated with variables such as GPA, behavioral incidents, and student achievement. Student responses are given a score of 1 to 4 based on their responses of strongly disagree (4) to strongly agree (1), except for 2 questions which are reverse scored. Lower scores indicate greater student engagement.

Data Analysis

Data were collected on the three students in the study. Thus study focused on conducting a more descriptive, exploratory analysis, with the intention of understanding trends and patterns within the data, both for individual students and across participants.

- *Time in class* – individual student averages were computed for the number of minutes spent in class for the week prior and each week of the unit. A trend line for the average of all students' minutes in class across the unit was generated. These were used to identify changes in the amount of time spent in the classroom for any individual students, as well as overall.

- *Behavior points* – weekly averages were computed for overall lesson behavior points for individual students. Additionally, separate averages were determined for student scores on completing work accurately and on time. This allowed for an understanding of changes in student rule compliance as well as work completion.
- *Grades* – grades were converted into a percentage score for each week, in order to account for variations in the scores assigned to assignments.
- *Student Engagement Instrument* – the instrument contains 6 engagement subscales, 3 cognitive and 3 affective. Analysis focused on the changes before and after the gamification unit in students total scores, and scores on the affective and cognitive subscales; in order to determine if there were substantial changes for any students.
- *Field Notes* – a qualitative analysis was done on the field notes, analysis focused on determining if the field notes corroborated the behavioral engagement data and understanding of student perceptions and investment in the gamification system. Recurring themes in the notes were identified and categorized to understand student perceptions of the system, academic progress and behavioral engagement.

Results

Data were collected from 3 students over the course of the 2 week unit, and for one week prior to the start of the unit. Student 2 was absent for day 4 of the gamified instruction unit, otherwise there are no missing data points. The emergence of patterns and

trends in the data were observed and trends used to understand the impact of a gamified math curriculum on student school engagement.

Behavioral Engagement

Time in class, grades, work completion, and overall behavior points for the lesson, were used as measures of behavioral engagement. Time in class was measured through recording the number of minutes the students were present in the classroom, a maximum of 45 minutes for each lesson. Figure 2 shows trend lines for each students minutes in class the before and during the gamified unit. Students 1 and 3 showed little change in their minutes in class before and during the unit, with their trend lines indicating their minutes in class are stable. Student 2 in contrast had a noticeable change in their minutes in class, before the unit they had a decreasing trend consistently below 30 minutes per lesson, while during the unit their minutes are increasing and were consistently above 35 minutes. Furthermore, Table 1 highlights individual student's average time in class for each week of the study (one week prior to the gamified unit and the two weeks during). Students 1 and 3 do not show particularly large changes across the unit, although there is a slight decline in Student 3's minutes in class in the last week of the unit. Contrastingly, Student 2 shows a large change, increasing from an average of 27 minutes in class prior to the start of the unit to 39 minutes in week 1 and 38 minutes in class during week 2 of the unit.

Figure 2. Student time in class per lesson.

Table 1

Individual student average time in class by unit week.

Student	Pre Unit	Week 1	Week 2
Student 1	45	45	45
Student 2	27	39	38
Student 3	45	45	43

Academic work completion was measured in two ways. Firstly, student grade percentage before and during the unit, grades in the class were given by the normal classroom teacher and represented generally student completion of the task and effort put into the completion, as well as scores on weekly assessments. The other measure is the daily behavior score for 'complete tasks accurately and on time' this is a rating given to the students each period from 1 to 6, a 1 indicates the student completed no work, while a 6 indicates they completed additional work than was expected. The individual trend lines in Figure 3, show the greatest change from baseline in students 1 and 3; student 3 although their trend line was not increasing during the unit their points were more stable and higher

overall. Of note, day 5 of the baseline data is a likely outlier in student data, the students' received a 6.0 for ignoring a significant disruption to the classroom, and so the decline in their overall points during the instruction unit is not as dramatic. Student 2, however, had a large jump in their score per lesson from the baseline unit, to the gamified lessons. When considering students individually in Table 2, Student 2 had a large increase between the pre-unit week and the first week of the unit, and although his average points did decrease from week 1 to week 2, they still remained higher than their baseline week. Similarly, Student 3 showed a very slight increase from the pre-unit to the unit, and no change was noted for student 1. Individual student grades showed similar patterns to the behavior points as seen in Table 2 and 3, Student 2 increased significantly from the pre-unit week; and their grades showed a less drastic decline between weeks 1 and 2. Students 1 and 3 in contrast to their point averages, had more prominent declines in their grades between week 1 and week 2 of the unit; Student 1 even performed below his baseline in week 2 of the unit.

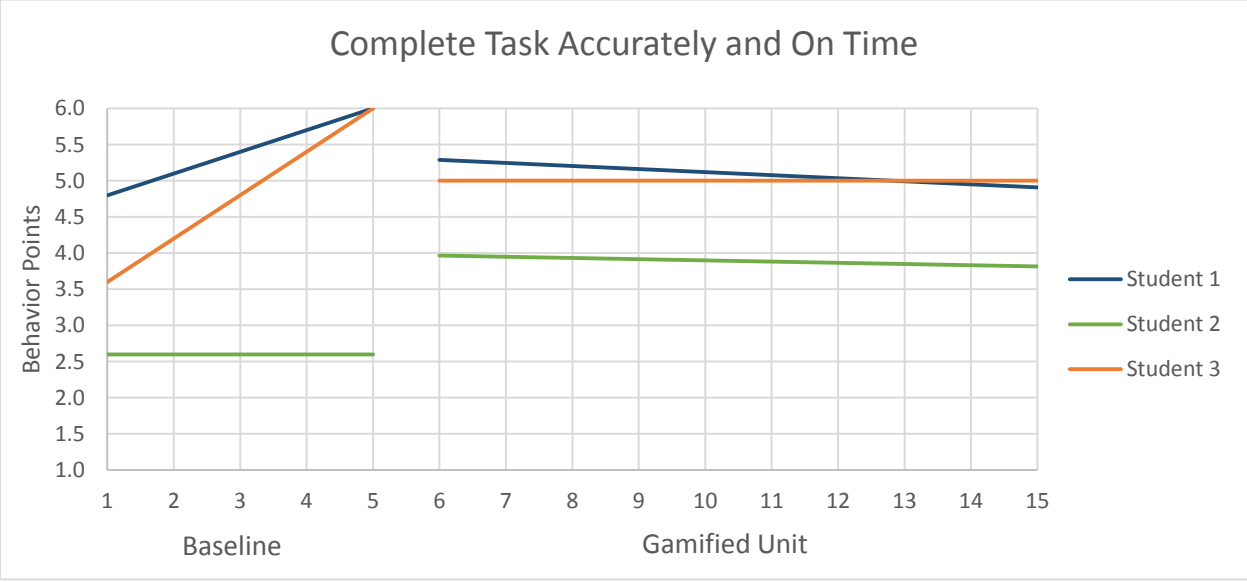

*Figure 3. S*tudent points per lesson for 'Complete Tasks Accurately and on Time'

Table 2

Individual student grade percentage by week.

Student	Pre Unit	Week 1	Week 2
Student 1	93.5	100.0	91.4
Student 2	39.1	65.3	63.4
Student 3	70.7	85.3	75.3

Table 3

Individual student average Points on Complete Task.

Student	Pre Unit	Week 1	Week 2
Student 1	5.4	5.2	5.0
Student 2	2.6	4.3	3.6
Student 3	4.8	5.0	5.0

Compliance with school rules and expectations was measured by the average behavior points score for each lesson, all rules are measured on a 1 to 6 scale, and an average score of 5 would mean the students met each expectation with no reminders in the lesson. Figure 4 shows that there was little change in student average behavior points per lesson, indicating that overall there was no notable difference in student rule compliance in the gamified system over the standard non-gamified instruction. Similar patterns are found with individual student averages, Student 2 showing the greatest change from 4.4 prior to the unit start to 4.8 in week one. Notably all students fell below their baseline in week 2, though the biggest change in any score was 0.5, for Student 3, which remains a fairly small difference.

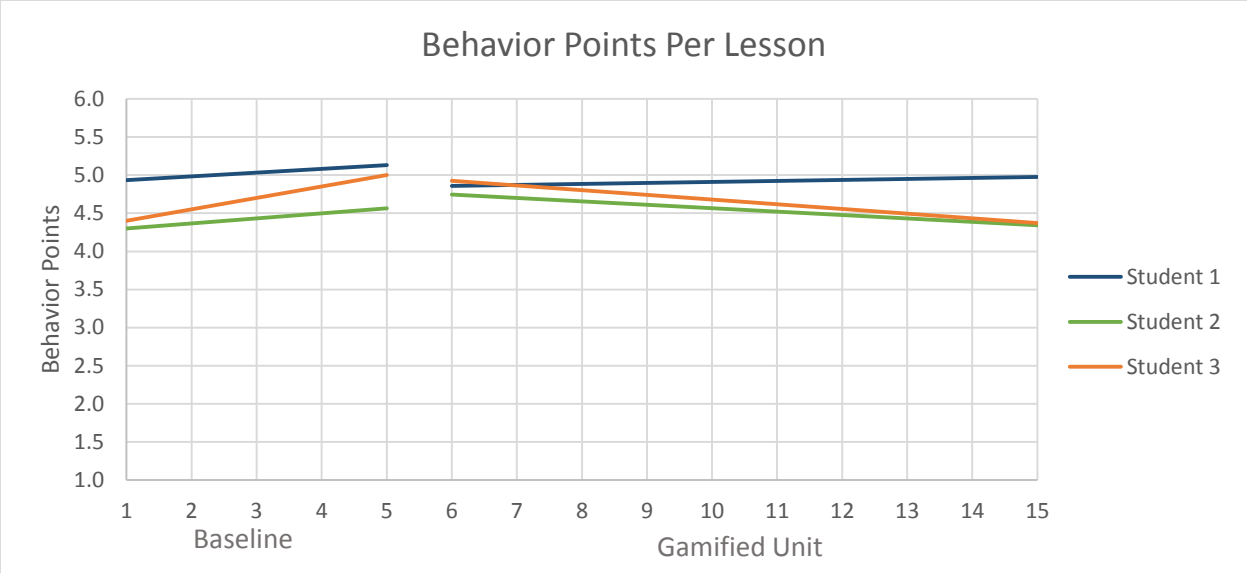

*Figure 4. S*tudent average behavior points per lesson.

Table 4

Individual student average Behavior Points.

Student	Pre Unit	Week 1	Week 2
Student 1	5.0	4.9	4.9
Student 2	4.4	4.8	4.3
Student 3	4.7	4.9	4.4

Affective and Cognitive Engagement

The Student Engagement Instrument (SEI) was used as a measure of student affective and cognitive engagement. The SEI contains subscales for affective and cognitive engagement, which can be further subdivided into components of each. Due to the small sample size analysis has focused on the score for the whole instrument and composite scores for affective and cognitive engagement. Student responses are given a score of 1 to 4 based on their responses of strongly disagree (4), disagree (3), agree (2), strongly agree (1), except for 2 questions which are reverse scored. Lower scores indicate greater student engagement.

There is some concern in the validity of these measures, in particular student 1 on their post-questionnaire answered the two reverse score measures as strongly agree, where on the pre-questionnaire one was answered as 'strongly disagree' and the other as 'agree'. While it is possible this represents a change in student 1's engagement, it is also possible they were not reading the questionnaire measures fully while completing the pre or post assessment. Given it is not possible to know for certain, the data is considered as is, assuming these are representative of the student's true responses.

Overall the results of the SEI indicate that students have high cognitive and affective engagement, both before the start and during the gamified unit. This can be seen in the average score per question which remains low across subscales on both the pre and post surveys. Only very slight changes can be seen in average scores, with the greatest difference being a 2 point increase in cognitive engagement. Somewhat larger changes can be noted when considering individual student data. Student 1 and 2 showed a very slight decrease in SEI score, suggesting an increase in overall engagement. Similarly, though they had only a small overall score decrease, student 2 had a decrease of 10 points for their cognitive engagement, and student 1 had a decrease of 9 points on their affective engagement. Interestingly, both students showed a switch in their subscale scores; student 1's affective engagement score increased while their cognitive engagement score decreased, in contrast student 2's affective score decreased and their cognitive score increased. Student 3 overall had an increase in their total score, suggesting lower engagement, though their subscale scores did not show the switch that was seen on the other students.

Table 5

Student Engagement Instrument

Student	Affective Pre	Affective Post	Cognitive Pre	Cognitive Post	Total Pre	Total Post
Student 1	29	20	19	24	48	44
Student 2	22	27	28	18	50	45
Student 3	27	32	21	20	48	52
Average	26	26	23	21	49	47
Minimum Score	19	19	16	16	35	35
Average per Qu.	1.37	1.39	1.42	1.29	1.39	1.34

Field Notes

Field notes were recorded and attached to the lesson worksheet after each class, the notes focused on three primary categories; academic, behavioral and gamification notes. Academic notes were comments on student understandings or struggles from the lesson, such as learning targets that might need to be revisited. Behavioral notes included any specific behavior plans students used in the lesson, student participation and presence in the classroom. The gamification notes related specifically to the game system that was implemented, this included direct student comments on the system, or ways that they engaged or did not engage in the gamified instruction.

The academic notes suggest that overall students had reasonable understanding of the material as it was presented in the lesson, but there were common areas where student's consistently struggled. After lesson 3 I noted students may need more explicit 'rules' for creating fact families, on the weekly assessment the fact family questions were the source of most student's errors; and as such this information was retaught with additional strategies in lesson 6, where the notes indicated much greater student success. Beyond a few small insights into student academic understandings, the academic field

notes largely support the data seen in the student's grades and work completion points, indicating students that scored well on the assessments were those with the most secure understanding of the material, and were in turn those that participated in the lessons most consistently. Similarly, the behavior field notes ae in line with the additional behavioral data that was collected. Of interest the notes do provide insight into student 2, who had an average in class time of 38 out of 45 minutes in class time, but only an average of 3.6 work completion; in the notes it states that student 2 was in his desk but not participating for a number of lessons in week 3, which explains the student's poorer academic performance despite being present in the classroom for a greater length of time.

The gamification field notes provide a unique insight into the student experiences of the system that are not seen through the other measures. Based on the field notes, overall the students were interested and engaged in the system; with a number of more specific trends that emerged. Firstly, the notes indicate there was rapid student buy in to the system. In lesson 1 of the gamified unit students initially expressed disappointment that the unit was not on the computer. As the lesson progressed, however, the students and I referred to each other by character names, and at the start of the second lesson the students requested their character sheets, including student 2 who had not participated in the class the day before.

Secondly, students expressed interest in the feedback components of the gamification system. Examples include, student 2 requested updated character sheets immediately after the end of a lesson, student 3 asked for skill stickers after the completion of the lesson, student 1 regularly asked for their character sheet at the start of a lesson, students 1 and 2 requested copies of their sheet to take home, and all students asked for

copies of their character sheets to be affixed to their desks. These suggest students had an interest in the feedback that was provided by the system, and were invested in their characters and by extension their own progress. Thirdly, the field notes indicate students were oriented towards the goals set by the system. For example, student 2 expressed in a number of lessons that they needed to complete the assignment in order to gain their full XP. Similarly, students wanted to know what level they would be able to reach by the end of the unit, and were willing to complete bonus missions in order to level up faster. Lastly, students incorporated a social element into the system they were interested in their fellow classmate's performance, asking about their current level, and giving positives to each other at the start of the lesson when they received their updated sheets.

Discussion

Although the quantitative data did not strongly support the effect of gamification in increasing student engagement, the general trends seen in the data suggest future study is warranted. Based on this exploratory analysis there were small shifts seen in the behavioral data, for example the results showed that there was an increase in students' grades, task completion, and the average number of minutes spent in class during the course of the gamified unit as compared with the week prior. Overall trends across students showed improvements in behavioral engagement over the course of the 2 week gamification unit, with one of three participants showing substantial changes from the week prior to the gamified unit.

Additionally, the field notes recorded during the gamified unit suggest students were interested and invested the gamified instruction, for instance referring to their classmates by character names, requesting updated character sheets and skill stickers,

asking classmates about their current level and completing academic assignments in order to gain full XP for the lesson. While there is not formalized data on student perspectives of the system, the field notes suggest a strong interest in the system which supports the behavioral engagement data. This consistency in the findings suggests that some increase in student behavioral data could be attributed to the gamification and not to other extraneous variables. Overall this exploratory study suggests there is value in additional research into the use of gamification of student instruction, as well as providing direction for classroom teachers to utilize gamification within their classrooms.

Limitations of Current Study

There are a number of limitations to this current study. Primarily due to the small sample size of only 3 students it is difficult to draw wider conclusions about the impact of gamification on student engagement, as well as conduct statistical analysis to determine significance of findings. For example, two of the students showed very little change in engagement over the course of the study, which may be due to students already having high engagement prior to the gamified unit. This can be seen in behavioral measures including grades and time in class, as well as affective and cognitive engagement based on their SEI scores. It is almost impossible to determine how effective the gamification of instruction may have been if these students had much lower engagement before starting the unit, it may be that gamification is a tool for increasing engagement not for initiating it. Given this it would be unlikely for the students to show an increase in measures of engagement over the course unit, and larger sample sizes would be needed to see significant effects. Furthermore, the students are likely not representative of students with

emotional behavioral disabilities as a whole, and very different results would be seen with students with different interest in games, cognitive abilities, or behavioral challenges.

In addition to the small sample size the unit took place over only 2 weeks of instruction. Though results indicate this short time frame had some impact on engagement it would be important to increase the length of gamified instruction time to better understand the long term impact. All three students who participated in the study showed reduced measures of engagement in the second week of the unit, which given the length of the unit it is difficult to determine if this would have continued as a trend or if it is simply reflective of expected variations in engagement over time. It is possible the increase in engagement seen the first week of the unit was due to the novelty of the system, and would not have shown sustained engagement in a longer study. Conversely a longer unit might have given time for student engagement to continue increasing and stabilize, showing less variation over time.

Lastly, there was no analysis of academic changes in mathematical understandings. While student grades and work completion increased in the gamified unit, these are primarily concerned with work production and not work quality of mathematical understanding. The field notes provide a small insight, suggesting the students did not struggle more with mathematical concepts during the unit than before, however, they are not sufficient for identifying larger patterns in student understandings, or determining if students were making more or less progress in the unit than in non-gamified instruction. This relates to the brevity of the unit, as the unit was too short to administer curriculum based measurements or other standardized assessments to compare student progress with the gamified instruction to same aged peers. Similarly, the unit covered a variety of

mathematical concepts and there was no control to compare the students' progress to in order to determine changes in mathematical understanding.

Directions for Further Research

The current field of research into gamification had largely been focused on industry and consumer technology, very little has been directed at the field of education and applications within a classroom (Deterding et al., 2011; Hamari et al., 2014). What does exist related to education is heavily dominated by theory from game designers and educators which, while insightful, does not provide an evidence base for practitioners to base their teaching on. This study provides an initial research exploration of the impact of gamification on student engagement. Though the study has a number of limitations, it provides strong implications that further research into this area will provide valuable understandings of the potential of gamification as a tool for increasing engagement.

Future research should focus on increasing the sample size and duration of the gamified unit. Larger sample sizes will allow for the use of more robust statistical measures in determining if there is a significant impact on student engagement, as well as ensuring that the sample size is more representative of the population at large. Increasing the diversity of the sample is also necessary, inclusion of girls, students with no interest in games, elementary and high school aged students, and potentially students in general education or other disability categories. All of these would allow for a broader understanding of gamification as a teaching tool, and the relationship to student engagement. Though the current study indicates it may be an effective method for improving student school engagement, this may only apply to the students that participated in the study, and cannot be extended beyond them without future research.

Increasing the length of the gamification unit in any future research is important to understanding the sustained impact gamification may have on engagement. As noted earlier it is possible that a longer unit would have revealed that gamification does not produce sustained engagement, or conversely gamification in the long term may increase and then stabilize student engagement at the higher level. Without longer studies this impact cannot be known. Similarly, longer studies are needed in order to assess changes in student academic understandings in gamification versus non-gamified teaching units.

Implications for Practitioners

The intention of this study was to support practitioners interested in using gamification in their instruction as a means for increasing student school engagement, particularly for those students most at risk for low engagement. This study provided a model for the implementation of gamification in the classroom in order to support student engagement. Gamification will not on its own ensure the engagement of students in class, but it can provide another means of promoting students' active participation and investment into something beyond the academic expectations of a lesson. Gamification should be used as an adjunct to other well supported engagement strategies, and the recommendations of this study are focused on the implementation of gamification at the classroom level.

Prior to the implementation of gamification in the classroom teachers need to determine the needs and interests of them and their students, as well as what they wish to achieve through the implementation of a gamification system. Teachers will need to negotiate students with varying interest and understanding of games, different technology requirements, and different abilities to put in effort to maintain the system. The system

used in the study was designed for students with interest and understanding of games, the need for little to no technology to implement, and without much concern for the additional time to maintain the system.

With an understanding of their needs and limitations teachers can approach the development of gamified instruction. The design of the gamification structure used in the study was based on first focusing on the incorporation of the core elements of a game, feedback, objective, rules and voluntary participation; and then determining the game mechanics that would be used to incorporate these elements within the system. During the course of the study students were interested in receiving the feedback that was provided by the system, such as requesting updated character sheets, as well as being oriented towards the objectives provided by the system, as seen by them wanting to earn all the possible XP in order to level up. Though the interest was not the same for all students, some preferred the skills stickers while others were more interested in earning XP, suggesting the focus on incorporating the core elements of a game with a number of mechanics for each, was important for increasing student buy in to the system. Further to that, it is these core elements that are part of how games produce flow states and engage players, thus ensuring their incorporation will orient the gamified instruction more towards bringing flow into the classroom, and increasing the potential for the system to engage students. To that end it is recommended that teachers implementing gamification take the same game element first, mechanics second approach when creating their systems.

The following are consideration teachers should make when approaching gamification from a ‘game elements first’ perspective.

- Voluntary participation can be difficult to archive in a school setting, consider allowing students to opt out of the system, or even just specific elements; for example students may not wish to be in competition with their classmates, or would prefer to not create a character.
- Ensure that the system has long term and short term objectives students are working towards, with variety in the types of goals and the difficulty of achieving them.
- Provide frequent positive feedback on student progress towards all their objectives, ideally feedback would be instant.
- Establish clear and consistent rules for how students make progress within the system and reach their objectives.

Once these elements are considered it is possible to select the mechanics most appropriate for the classroom setting that will incorporate these into the gamified system. There is no one set of best mechanics, and the mechanics selected should be based off student needs and interests, for instance feedback might be done through giving experience points or it might be filling up stickers on a chart.

Teachers and education professionals are concerned about many students lack of school engagement, which is particularly worrisome due to the increased risk for poor school outcomes for these disengaged students (Archambault et al., 2009; Janosz et al., 2008; Reschly & Christenson, 2006; Upadyaya & Salmela-Aro, 2013). In contrast, individuals who play games are willing to engage in sustained challenging and difficult tasks, likely because these games reliably produce a flow state (Csikszentmihalyi, 1990, 2000; McGonigal, 2011; Sweetser & Wyeth, 2005). Through gamification of education the

intention has been to incorporate the aspects of games that produce flow into the school setting, in order to increase student school engagement (Deterding et al., 2011; McGonigal, 2011). This study explored a gamified mathematics instruction unit and found gamification to be a potential tool for increasing student engagement. Throughout the unit students expressed an interest in the gamified instruction system, and when considered individually they showed improvement in behavioral measures of engagement. Based on this research the principal suggestion for teachers who want to gamify their instruction is to focus on the four core game elements; feedback, objective, rules and voluntary participation, in order to approximate a flow experience in the classroom. While gamification is unlikely to engage all students, it can be an effective tool for increasing student engagement and fostering the success of high risk students.

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Appendix 1: Lesson XP and mission breakdown.

Lesson	XP	Activity	Total XP
1	25	Math Minute	300
1	65	Participation	
1	35	Exit Ticket	
1	50	Mission 1 - True/False Intro	
1	75	Mission 2 - Open Sentences	
1	50	Bonus Mission - </>/=	
2	25	Math Minute	300
2	65	Participation	
2	35	Exit Ticket	
2	50	Mission 1 - Chip Strategy	
2	75	Mission 2 - +/- Conversion	
2	50	Bonus Mission	
3	35	Math Minute	390
3	85	Participation	
3	50	Exit Ticket	
3	30	Mission 1 - Fact Family intro	
3	60	Mission 2 - Negative Fact Families	
3	80	Mission 3 - Fact families with n	
3	50	Bonus Mission - Solve for n	
4	50	Math Minute	510
4	130	Participation	
4	75	Exit Ticket	
4	40	Mission 1 - Coordinate Review	
4	65	Mission 2 - Intro to 4 Quadrants	
4	150	Mission 3 - Quadrant Practice	
5	760	Mini Boss Battle	
6	75	Math Minute	760
6	190	Participation	
6	115	Exit Ticket	
6	80	Mission 1 - Fact Family intro	
6	125	Mission 2 - Negative Fact Families	
6	175	Mission 3 - Fact families with n	
6	75	Bonus Mission - Solve for n	
7	95	Math Minute	950
7	235	Participation	
7	145	Exit Ticket	
7	75	Mission 1 - Repeated +/-	
7	200	Mission 2 - Generating algorithm	

7	200	Mission 3 - multiplying negatives	
7	75	Bonus Mission - multiplying fractions	
8	115	Math Minute	1140
8	285	Participation	
8	170	Exit Ticket	
8	150	Mission 1 - x/ fact families	
8	200	Mission 2 - Generating algorithm	
8	220	Mission 3 - dividing negatives	
8	100	Bonus Mission - x/ solve for n	
9	130	Math Minute	1280
9	320	Participation	
9	190	Exit Ticket	
9	100	Mission 1 - Review algorithm	
9	540	Mission 2 - Independent Practice	
10	1280	Boss Battle	

Appendix 2: Example worksheet and boss battle.

Name: _____

Date: _____

The Equal Sign

Mission 1 (50 XP):

The Equal Sign (=):

1. _____
2. _____
3. _____

12 + 7 = 19	8 – 6 = 4	40 = 15 + 25
9 = 6 + 3	3 + 7 = 7 + 3	9 + 5 = 0 + 14
10 - 3 = 11 - 7	2 x 8 = 4 x 4	9 = 9
15 = 3 x 5	5 = 7	6 x 2 = 7 x 1

Mission 2 (75 XP):

___ - 1 = 11 - 7	14 - 6 = 15 - ___
___ - 4 = 5 + 2	3 + ___ = 13 - 1
___ + 10 = 2 + 15	7 + ___ = 6 + 14
15 - 1 = ___ - 4	1 + 12 = 5 + ___
14 - ___ = 3 + 4	1 + 3 = 11 - ___
___ + 5 = 14 - 2	15 - ___ = 14 - 7
14 - 3 = ___ + 1	1 + 11 = ___ + 5
4 + 2 = ___ - 5	12 - 3 = 2 + ___

Name: _____

Date: _____

Bonus Mission (50 XP):

6 – 3 ____ 1 + 2	9 – 8 ____ 13 - 11	16 - 3 ____ 8 + 4
13 – 7 ____ 16 - 9	3 + 4 ____ 9 - 2	4 + 3 ____ 6 - 2
14 – 9 ____ 13 - 10	1 + 2 ____ 5 - 4	12 – 6 ____ 4 + 1
16 – 4 ____ 6 + 3	9 + 15 ____ 7 + 15	8 + 3 ____ 14 - 2

Exit Ticket (35 XP):

Are they equivalent? Write True or False (T/F), for each equation:

16 = 9 + 7	7 x 2 = 14 x 1	12 – 4 = 5

Complete the equations to make then true:

6 + 14 = 12 + ___	13 - ___ = 15 - 6
___ + 9 = 8 + 13	12 - 4 = 5 + ___

Name: _____

Date: _____

Final Boss Battle!

Wither

XP Total: 1280

1. **Circle the correct algorithm for multiplying and dividing negative numbers:**

   a. (+) x/÷ (+) = (-)
   (-) x/÷ (+) = (+)
   (+) x/÷ (-) = (-)
   (-) x/÷ (-) = (+)

   b. (+) x/÷ (+) = (+)
   (-) x/÷ (+) = (-)
   (+) x/÷ (-) = (-)
   (-) x/÷ (-) = (+)

   c. (+) x/÷ (+) = (-)
   (-) x/÷ (+) = (+)
   (+) x/÷ (-) = (+)
   (-) x/÷ (-) = (-)

3. **Write the fact families for the equations.**

(+8) + (-10) = (-2)	(+27) − (-13) = (+40)

4. **Write the fact families. Then find *n*.**

(-2) + *n* = (-8)	(+12) − *n* = (+17)

Name: _____

Date: _____

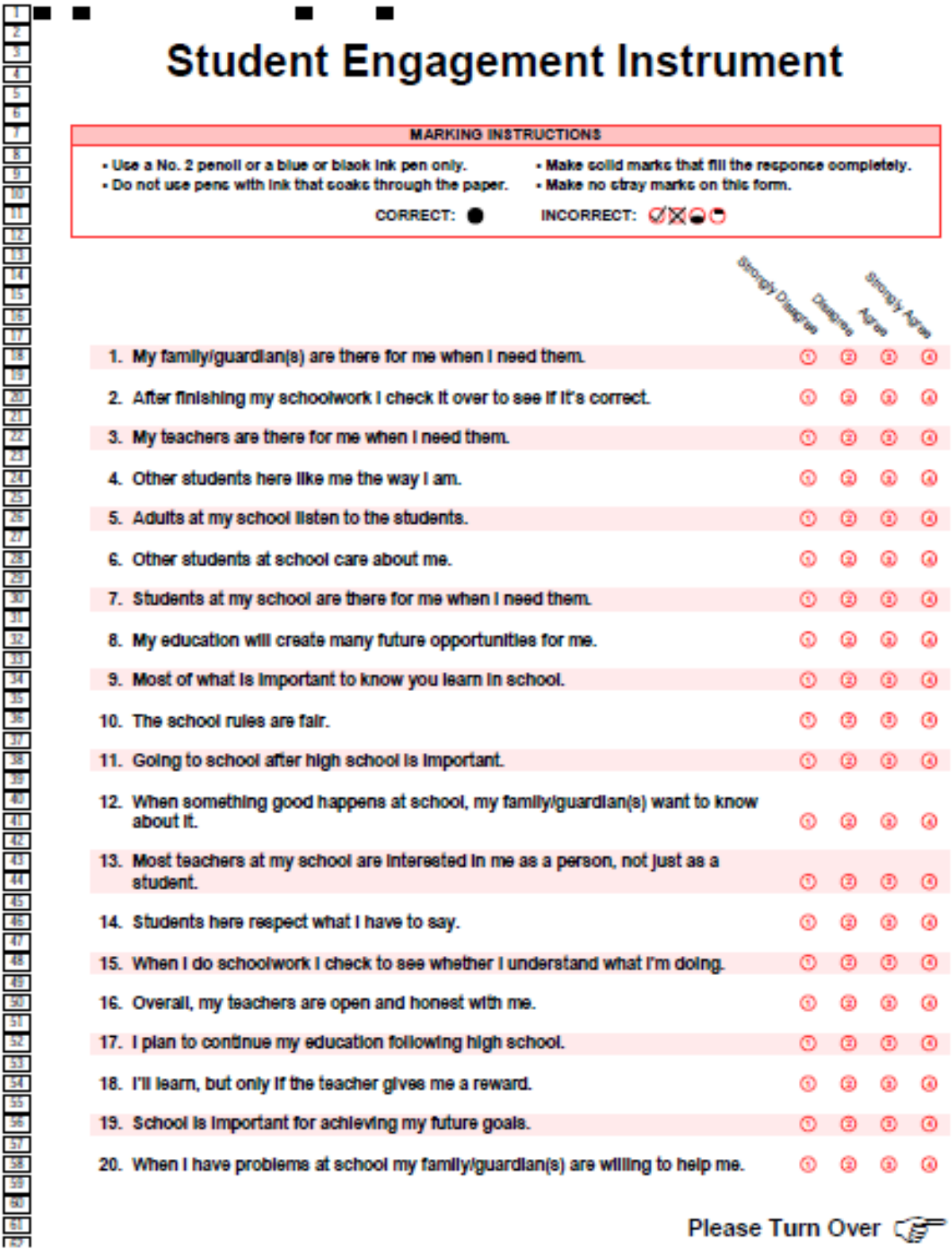
5. **Write the Fact Families for the following equations:**

(+8) x (-10) = (-80)	(-21) ÷ (-7) = (+3)

6. **Solve the following equations:**

-35 ÷ 7 =	-4 x -6 =
-88 ÷ -11 =	-3 x -6 =
48 ÷ -6 =	-5 x 4 =
-30 ÷ -5 =	2 x -8 =
36 x -6 =	-9 x -9 =

Appendix 3: Student Engagement Instrument



Student Engagement Instrument

MARKING INSTRUCTIONS

- Use a No. 2 pencil or a blue or black ink pen only.
- Do not use pens with ink that soaks through the paper.
- Make solid marks that fill the response completely.
- Make no stray marks on this form.

CORRECT: ● INCORRECT: ⊘ ⊠ ◒ ◓

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My family/guardian(s) are there for me when I need them.	①	②	③	④
2. After finishing my schoolwork I check it over to see if it's correct.	①	②	③	④
3. My teachers are there for me when I need them.	①	②	③	④
4. Other students here like me the way I am.	①	②	③	④
5. Adults at my school listen to the students.	①	②	③	④
6. Other students at school care about me.	①	②	③	④
7. Students at my school are there for me when I need them.	①	②	③	④
8. My education will create many future opportunities for me.	①	②	③	④
9. Most of what is important to know you learn in school.	①	②	③	④
10. The school rules are fair.	①	②	③	④
11. Going to school after high school is important.	①	②	③	④
12. When something good happens at school, my family/guardian(s) want to know about it.	①	②	③	④
13. Most teachers at my school are interested in me as a person, not just as a student.	①	②	③	④
14. Students here respect what I have to say.	①	②	③	④
15. When I do schoolwork I check to see whether I understand what I'm doing.	①	②	③	④
16. Overall, my teachers are open and honest with me.	①	②	③	④
17. I plan to continue my education following high school.	①	②	③	④
18. I'll learn, but only if the teacher gives me a reward.	①	②	③	④
19. School is important for achieving my future goals.	①	②	③	④
20. When I have problems at school my family/guardian(s) are willing to help me.	①	②	③	④

Please Turn Over ☞

	Strongly Disagree	Disagree	Agree	Strongly Agree
21. Overall, adults at my school treat students fairly.	①	②	③	④
22. I enjoy talking to the teachers here.	①	②	③	④
23. I enjoy talking to the students here.	①	②	③	④
24. I have some friends at school.	①	②	③	④
25. When I do well in school it's because I work hard.	①	②	③	④
26. The tests in my classes do a good job of measuring what I'm able to do.	①	②	③	④
27. I feel safe at school.	①	②	③	④
28. I feel like I have a say about what happens to me at school.	①	②	③	④
29. My family/guardian(s) want me to keep trying when things are tough at school.	①	②	③	④
30. I am hopeful about my future.	①	②	③	④
31. At my school, teachers care about students.	①	②	③	④
32. I'll learn, but only if my family/guardian(s) give me a reward.	①	②	③	④
33. Learning is fun because I get better at something.	①	②	③	④
34. What I'm learning in my classes will be important in my future.	①	②	③	④
35. The grades in my classes do a good job of measuring what I'm able to do.	①	②	③	④