Motivational Effects of Gamification of Piano Instruction and Practice

by

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Abstract

Gamification refers to the process whereby game design and game mechanics are applied in non-game contexts to influence behaviour. This research study explores the effects of gamification on piano students' practice of technical elements such as scales, chords, and arpeggios, within the private lesson environment. A control and a treatment group of 10 piano students each were formed across two different private piano studios. A game called *Technique Tower* was designed for the treatment group, in which the players experienced game elements such as rewards (points, badges, and levels), avatars, and the sharing of their progress in an online social context. Gamification was found to have a positive effect on the number of technical elements students mastered, and on their attitude toward practicing technical elements, while self-efficacy levels were not affected. The educational implications for this finding are discussed.

Dedications and Acknowledgments

To my piano students, who give me great joy when they grow musically.

To my colleague, Dawne, who is incredibly musical, and willingly participated in this study, giving wise, thoughtful feedback throughout.

To my mom, Rebecca, for blazing a trail as an excellent teacher and lifelong learner, and for enthusiastically cheering me on when I was in desperate need of encouragement.

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"I was pushed hard, so that I was falling, but the Lord helped me."
(Psalm 118:13 English Standard Version)

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CHAPTER 1: INTRODUCTION

Training to be a piano player is a process not unlike training to be an athlete (Martin, 2008). Physical skills must be developed in order to execute piano pieces, in the same way that physical skill development is necessary to succeed in athletic endeavours. The time that a piano teacher spends with students in weekly lessons, often ranging between 30 to 60 minutes, is not enough time for those students to develop the physical skills necessary to become accomplished players. Regular practice is essential to becoming proficient. Practice is defined by Austin and Berg (2006) as the process of "learning through systematic experience or exercise" (p. 535). It is referred to as "one of the most fundamental musical behaviors necessary to achieve success on a musical instrument" (Schatt, 2011, p. 2). While a piano teacher can employ strategies and techniques to increase student engagement within the piano lesson, what happens outside of lessons is crucial and more difficult for the teacher to influence.

The Importance of Technical Exercises

Technical exercises, such as scales, chords, and arpeggios, are an important part of regular practice which teachers often assign for students to practice between lessons. These exercises can be likened to stretching before a sport in that they are important for warming up the fingers so they will be at maximum flexibility before tackling intricate,

complex pieces. The exercises consist of patterns that develop a musician's "physical control over the interface between their body and their instrument" (Green, 2007, p. 84). This skillful technique cannot be developed by playing technical exercises just once per week during lessons.

Practicing technical exercises is a significant part of a balanced piano instruction program. Such practice provides opportunities to develop fingering techniques such as learning to quickly tuck fingers under, stretch fingers, reach to distant notes, and play many notes at a time using the correct fingers; techniques that, with practice, lead to an "ease and control over the keyboard" (Bastien, 1988, p. 130). Bastien additionally lists the following benefits of practicing technical exercises: developing balance between the hands, developing hand coordination and independent function, developing a balanced tone, developing dynamic control, and developing the ability to anticipate what comes next. Since music is often based on scale, chord, and arpeggio patterns, practicing technical exercises provides opportunities for student success when a student tackles a piece which contains one of the patterns. As an example, the E-flat major scale appears in this Haydn sonata, where players must strive for a smooth, even, rhythmic execution (See Figure 1). Practicing the E-flat major scale with the right hand, in isolation, will facilitate student success in this circumstance.

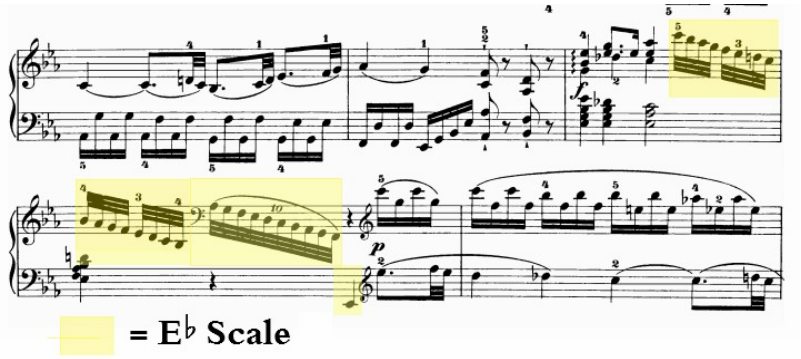

Figure 1. Piano Sonata No. 62 Hob. XVI:52, E-flat major (Haydn, Joseph), Public Domain.
Listen: http://soundcloud.com/heather-birch1/e-flat-scale

Considering the importance of practicing technical exercises, it is problematic when students avoid practicing them regularly; students find them boring, repetitive, useless, or difficult. According to a study by Cooper (2001), 564 piano players who had taken lessons at many different ages consistently rated technical exercises as their least favourite part of piano study. During graded examinations in which students are asked to perform ear tests, pieces, and technical requirements, the technical requirements are often the weakest of the three, and cause great frustration for students (McPherson & McCormick, 2006, p. 333).

Gamification Proposed as a Motivator

The current research study was inspired by the unique role of these vital and profitable technical exercises that are frustrating to, and viewed negatively by students. This complicated scenario prompted the consideration of a strategy that could be used to increase student motivation to practice technical exercises, and also improve student

attitudes toward this practice. The strategy chosen is known as *gamification*, which is defined as "the use of game design elements in non-game contexts" (Deterding, Dixon, Khaled, & Nacke, 2011, p. 9). The game design elements which were implemented in this study to test for an effect on student motivation included awarding points and virtual trophies for beating levels, randomly awarding bonus stars for special achievements, the use of avatars, and the sharing of student progress online. It was anticipated that gamification could, in fact, motivate students to practice technical exercises, which would result in increased practice time and be indicated by improved student achievement.

The case of a music teacher employing a strategy to motivate students to practice is certainly not new. Publications such as *American Music Teacher* and *Canadian Music Teacher* feature many articles dedicated to examples of this, where teachers describe practices such as posting student awards on the classroom wall, and rewarding positive behaviour with treats. However, this study is unique because it a) fulfills the need to do formal research on this type of strategy, particularly in the context of private piano study, b) considers a non-game context, i.e. private piano lessons, as linked with an online environment where student progress is tracked, shared, and commented on, and c) uses only intangible rewards as motivators.

This research study was designed to address the question: Does gamification have an effect on students' practice of technical exercises within the private piano lesson environment? The sub-questions to be asked include: 1) Does gamification affect piano students' motivation to practice technical exercises? 2) Does gamification affect the self-

efficacy levels of piano students? 3) Does gamification affect the attitude of piano students towards practicing technique? 4) Is gamification perceived as an enjoyable and effective motivator?

Literature Review

Much of the research about student practice habits and motivation in the context of music education is done in schools, where students learn their instrument in a classroom setting, alongside numerous other students (Jorgensen, 2008; St George, Holbrook, & Cantwella, 2012). Music education research conducted in the context of private music studios is less common. In these settings, students learn in one-on-one weekly lessons with a teacher where the importance of independent practice is heightened, since they do not have multiple classes throughout the week to interact with their teacher (Ericsson, Krampe, & Tesch-Römer, 1993; Pitts, Davidson, & McPherson, 2000). These students, together with their parents, can decide at any time to stop attending lessons, and they have no compulsion to continue until the end of the year or semester.

Music education takes many forms including school music programs, bands, choirs, community music schools and private studios. While these various music education environments likely share commonalities, there is little research available that discusses these similarities. Jorgensen (2008) observes that values representing political, religious, family, commercial, and professional interests may differentially influence each specific environment. She suggests that “although music education thrives in situations that are sometimes regarded as remote from, distinct from, or tangential to school music

programmes, these instances also need to be thought of as central to music education and studied by its researchers" (Jorgensen, 2008, p. 333). This study conducts research in one of these alternate environments, that is, a private music studio environment, and considers the impact of gamification.

Gamification

The idea of gamification as a pervasive phenomenon was first predicted by Jesse Schell at the February 2010 DICE (Design Innovate Communicate Entertain) conference. In his presentation called, "The Future of Games," Schell (2010) shared his vision that game elements will gradually encroach upon more aspects of our daily lives until they are ubiquitous. The term gamification has since become popular with the publishing of books such as "Game Based Marketing" by Zichermann (2010), and "For the Win" by Hunter and Werbach (2012). In these books, gamification is described in business and marketing contexts, for the purposes of building brands, increasing employee productivity, and selling products and services (Hunter & Werbach, 2012; Zichermann, 2010).

In comparison, gamification in educational contexts is done with the intent to increase student motivation and student learning. Notably, the process of gamification in an educational context does not consist of adding a game in order to teach knowledge or skills; rather, it consists of integrating characteristics of games that are engaging, and which have the potential to facilitate student learning, into an existing learning domain. Game elements are added to a learning environment in an effort to increase engagement and increase desired behaviour.

Emerging research on video games makes bold claims concerning their potential to enhance learning. Video games are purported to increase learning (Bavelier, Green, Pouget & Schrater, 2012), facilitate learning skill transfer, (Green & Bavelier, 2012), and promote prosocial behaviour (Whitaker & Bushman, 2012). Game-playing is also shown to increase a player's sense of self-efficacy in an academic context (Barab, Thomas, Dodge, & Carteaux, 2005). In response to these powerful claims, educational researchers have just begun to explore the elements which comprise games that make them effective learning tools, and how those same elements can be harnessed in traditional, non-game learning contexts (Deterding, Dixon, Khaled, & Nacke, 2011, p. 9). Some critics of gamification are concerned that the term is just a new name for a practice that has been used in education for many years (Kirk & Harris, 2011). This would be the case only if the term gamification was mistakenly applied to a simple one-dimensional system where a reward is offered for performing a certain behaviour. Indeed, this has been tried in many learning contexts with varying rates of success. Gamification, however, takes into consideration the variety of complex factors which make a person decide to do something; it is a multifaceted approach which takes into consideration psychology, design, strategy, and technology (Werbach, 2012).

Gaming Elements

Gaming elements which have the potential to increase motivation and learning, as defined by Karl Kapp (2012) include story, characters, recognition, chance, replayability, aesthetics, time, and continual feedback. In the context of this research study, a game called *Technique Tower* was designed for the control group to play. The mechanics

integrated into this game included story, replayability, recognition, social context, and control. Previous research suggests how each of these elements has the potential to positively affect motivation.

Story

Story comprises the elements of characters, plot, tension, resolution, and conclusion (Kapp, 2012). Learning in the context of story comes naturally, since the human brain is wired to resonate with narratives (Green & Brock, 2000). Learners recall facts more accurately and are prompted to think more deeply when those facts are presented in a story, as opposed to presented in a list (Kapp, 2012; Green & Brock, 2000); these capabilities of story give learners increased opportunities for success (Green & Brock, 2000).

Replayability

In a game environment, failing and trying repeatedly is often commonplace. In order to reach mastery, repetition of each level is expected before moving on to the next learning challenge. This is in contrast to conventional learning environments which are characterized by a limited number of opportunities to acquire skills and demonstrate understanding. Game environments are not easy, however. Video games, for example, are often extremely challenging, and take a long time to play (Gee, 2003). But scaffolding is also part of the environment, such that players are not on their own to figure things out; within the game, they get tools and have access to technologies that are ideally suited to their goals, and that help them achieve mastery of content and effectively solve problems

(Gee, 2003, Vygotsky, 1933/1978). The idea of getting something wrong, in a game, is often thought of as exploration and discovery, and not characterized as failure. This reduces participants' fear of making a mistake while engaged in a task. Players get as much time as they want to practice and to apply their learning to other similar situations, as well as new and unfamiliar situations (Gee, 2003). Players move up from one level to the next, just as they are ready to encounter the next level of difficulty.

Recognition

Kapp (2012) is hesitant to include recognition elements such as points, badges, and rewards in his list of game mechanics. He is wary of the view that gamification consists only of the awarding of points and badges, and maintains that these rewards are actually the least important element of gamification (Kapp, 2012). Woodruff (2012) defends these types of rewards, suggesting that, in an educational context, awarding points to learners, while allowing them to progress through levels with increasingly prestigious titles such as *novice*, *apprentice*, and *expert*, can motivate learners and make them feel powerful, important and safe (personal communication, July 28, 2012).

Social Context

Alderman (2008) suggests that a sense of belonging in a social community is an opportunity for developing student motivation. Many online games feature this type of relational experience, and as Gee (2003) explains, "people find great pleasure, excitement, and fun in organizing themselves into cross-functional teams."

Control

In a game, players follow rules and conventions, but often have many choices about where to go next, and in what order to attempt challenges. This gives players a sense of ownership; as James Gee (2003) explains: “In good games, players feel that their actions and decisions... co-create the world they are in and shape the experiences they are having. Their choices matter. What they do matters” (p. 34).

These gaming elements, having been identified as effective means for engaging players, were chosen to comprise the gamification environment in the current study in order to test their effect on student motivation to practice technical exercises.

Technical Exercises

According to Davidson, Moore, Sloboda, and Howe (1996), successful musicians who achieve their musical goals are inclined to practice technical exercises such as scales, chords, and arpeggios, significantly more than musicians who are less successful. However, they also mention that these high achievers additionally spend time on informal pursuits such as improvising and creating. A sole emphasis on technique, then, is unnecessary and could potentially alienate students, so a balanced program is needed. The emphasis on technical exercises in the current study does not mean to suggest that this method is the only, or even the predominant, means for developing students’ technical ability, but rather, one critical element of a balanced music program. Although a qualitative study of 14 professional musicians indicated that most were self-taught and did not systematically practice technical exercises (Green, 2007), teachers should not

abandon the expectation that their students will practice these exercises. In fact, Green (2007) proposes that learning music informally causes musicians to miss out on the acquisition of certain knowledge and skills, explaining that "many popular musicians feel keenly their lack of formal education" (p. 216). This study is positioned as a means to investigate formal piano education and how maximum benefits for students might be achieved. The varying degrees to which students engage in practicing between each formal piano lesson will be informed by a consideration of motivational theory.

Student Engagement and Motivation

Motivation is an extremely important factor when it comes to music learning (Hruska, 2011). In the 1950's, much research about motivation was dominated by theorists such as B. F. Skinner (1958), who claimed that the facts and practices associated with reinforcement theory "have increased our power to predict and control behavior" (p. 94). Kimble (1956) endorsed the prevailing theory of that decade when he proposed a solution to the problem behaviour of Paul, a child who exhibited moodiness, aggression and stealing. Kimble suggested methods for motivating Paul to change his behaviour which were "implicit in the methods available for eliminating the bar-pressing response in the rat" (p. 113). He suggested: "Either one can feed the rat. (In this case that would mean giving Paul the affection he is striving for.) Or one can withhold reinforcement and alter the subject's undesirable habits" (p. 113).

Whether it was a new discomfort with the notions of controlling and altering behaviour, or whether it was failed attempts at controlling and altering people, the 1960's saw a new

perspective emerge. Researchers such as Bruner (1961) acknowledged that a decision either to act or not to act was much more complex than that which could be explained by the results of experiments on animals. They recognized that a motivational theory needs to consider the cognitive component of the uniquely human experience. They suggested that a more accurate picture of motivation acknowledges it as a complex phenomenon; not only do learners experience either more or less motivation, they also experience different types of motivation (Deci & Ryan, 2000). These types of motivation are determined by the root causes that lead a learner to act (Deci & Ryan, 2000). Learners have certain attitudes and specific, unique goals that determine their actions (Deci & Ryan, 2000).

Motivating learners, then, does not simply consist of thinking up ways to get them to practice the piano, or to get them to persist without giving up when a technical element is difficult. Rather, it is about discovering the reasons behind why a student chooses to practice or not practice, or to abandon or persist through a difficult task, and then using those insights to structure a motivating environment for learners. Alderman (2008) puts responsibility on teachers, saying they must "help students cultivate personal qualities of motivation that can give them resources for developing aspiration, independent learning, achieving goals, and fostering resiliency in the face of setbacks" and should "establish the climate for the development of optimal motivation" (p. 3). In the current study, gamification is proposed as a way piano teachers can work toward achieving the goal of providing an optimal environment for student motivation. Four prevailing motivational theories, in particular, provide insight into students' practicing habits, and imply several

ways in which the implementation of gaming techniques may influence and increase motivation. The relevant theories include self-efficacy, expectancy-value, flow, and self-determination theory.

Self Efficacy Theory

The theory of self-efficacy considers how learners' beliefs about themselves relate directly to their ability to achieve specific goals. Bandura (1977) defines it as "the conviction that one can successfully execute the behaviour required to produce the outcome" (p. 79). If students believe they are good at a certain task, that belief has a positive effect on the effort they put into the task, the perseverance with which they meet the task, their thought patterns about the task, and their emotional reactions to the task (Barry, 2007). Self-efficacy is distinct from self-concept in that it refers to a specific task, as opposed to belief about one's ability in a general domain (Ritchie & Williamon, 2011). In other words, self-concept refers to learners' views of themselves as musicians or as piano players, while self-efficacy refers to their belief that they can get through a difficult technical passage in a certain piece (Bong & Skaalvik, 2003). These specific beliefs are extremely powerful predictors of what a learner is capable of achieving (Bandura, 1997). Cooper (2001) found evidence that piano students who "rated their keyboard skills as 'very good' and 'pretty good' during childhood years were more likely to report enjoying lessons, liking to play better, and enjoying practicing" (p. 163).

Expectancy-Value Theory

Expectancy-value theory focuses on the worth that learners assign to various endeavours,

as influenced by their social context (Pintrich & Schunk, 1996). It assumes that if a learner places value on something they will be motivated to engage in it, and as a result, make the choice to continue learning (Ghazali & McPherson, 2009). The constructs within this theory delineate four ways in which learners assign value, and how that affects their motivation. These include attainment value, intrinsic motivation, extrinsic motivation, and perceived cost.

Attainment value. Attainment value explains how students focus on a specific task and decide its value (Barry, 2007). For example, the task of performing in an upcoming recital leads them to think about who will be in the audience, and how they want to be perceived by that audience. Based on those thoughts, they decide how important it is to spend time practicing.

Intrinsic Motivation. Intrinsic motivation is activated when learners engage in activities for their own sake, without being coerced, and they do so in pursuit of a genuine interest, a desire to learn, and/or a desire to be challenged (Alderman, 2008). Intrinsic motivation can cause learners to focus on the degree of fun and pleasure they experience when making music (Barry, 2007). Lepper (1998) defines it as "behavior undertaken for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes" (p. 292). Intrinsically motivated learners may choose to act based on feelings of curiosity, the desire to take on a challenge, or the desire to meet a personal mastery goal (Lepper, 1988, p. 295).

These considerations of intrinsic motivation suggest that if students experience a feeling

of enjoyment while practicing the piano, they will be more likely to perform the task than if they find it boring or have no meaningful connection to the activity. Intrinsic motivation is valuable since it results in learners bringing their own specific kind of attention and mental concentration to a task (Lepper, 1998). It has been shown to lead to high-quality learning, and creative expression (Deci & Ryan, 2000, p. 55). Gee (2003) describes how "humans and other primates find learning and mastery deeply, even biologically, pleasurable under the right conditions" (p. 24).

Extrinsic motivation. Extrinsic motivation leads learners to action based on reasons external to themselves (Alderman, 2008); it can cause students to act based on opportunities to demonstrate their skills, in order to gain recognition from their peers, teachers, or parents (Alderman, 2008). This compels piano students to focus on future goals such as trophies in competitions, good marks on exams, and scholarships, all of which can elicit approval from their peers, parents, and music teacher (Barry, 2007). Virtual rewards such as points and trophies on a webpage also fall into the category of extrinsic rewards.

Perceived Cost. Perceived cost compels learners to focus on the investment necessary to learn to play and whether it is worth it to them to spend the time required, especially in relation to other activities they value (Barry, 2007). Piano students will estimate how much time they will need to dedicate to practicing a certain piece or technical element, and decide if they are prepared to make that sacrifice. The sacrifice will include less time to spend doing other things, such as homework, sports or connecting with friends.

Flow Theory

Flow theory, put forth by Csikszentmihalyi (1990), describes what happens when a learner takes on a challenge which is at the ideal developmental level. “The concept describes a particular kind of experience that is so engrossing and enjoyable that it becomes autotelic, that is, worth doing for its own sake even though it may have no consequence outside itself” (Csikszentmihalyi, 1999). The task is challenging, yet achievable. Some of the elements that allow for learning in a state of flow include clear goals, specific feedback, focused concentration, and a feeling of control (Csikszentmihalyi, 1999, p. 825). Learning in a state of flow is highly motivational because it causes the learner to lose track of time as well as the environment outside the learning context (Csikszentmihalyi, 1999, p. 824).

Self-Determination Theory

Deci & Ryan (2008) acknowledge that it is difficult to pinpoint the exact effect of an intrinsic or extrinsic motivator on any one student behaviour. According to the self-determination view, the relationship between intrinsic and extrinsic motivation is not a dichotomy. Rather, the two forms of motivation can be considered on a continuum, on which various motivational factors can be described, ranging from autonomous and integrated characteristics, through to externally controlled motivators (Deci & Ryan, 2008). The two forms of motivation can also exist simultaneously (Lepper, Corpus & Iyengar, 2005). Harter (1981) introduced a measurement scale which became widely used to determine whether students self-identified as either more intrinsically or extrinsically motivated. The scale measured students’ actions as motivated by “challenge vs preference

for easy work, curiosity/interest vs teacher approval, independent mastery attempts vs dependence on the teacher, independent judgment vs reliance on the teacher's judgment, and internal vs external criteria for success/failure" (Harter, 1981, p. 300). In 2005, Lepper, Corpus and Iyengar used that scale, but changed it so that students would not be forced to choose between intrinsic and extrinsic motivations; rather, they asked students the "degree to which both intrinsic and extrinsic reasons independently accounted for their academic behaviors in the classroom" (p. 186). They found examples of students who enjoyed activities, while at the same time paid attention to the marks they would receive for their performance during those activities (Lepper et al., 2005). In discussing the implications of their study, Lepper et al. (2005) suggest the following: "Seeking only immediate enjoyment with no attention to external contingencies and constraints may substantially reduce a student's future outcomes and opportunities. Conversely, attending only to extrinsic constraints and incentives can substantially undermine intrinsic interest and the enjoyment that can come from learning itself" (p. 191). This balanced view of intrinsic and extrinsic motivation takes practical considerations into account, and describes how extrinsic means often co-exist with intrinsic needs (Deci & Ryan, 2000).

Balancing Intrinsic and Extrinsic Motivation

Effective strategies to facilitate intrinsic motivation in student learners include: providing challenging activities (Lepper, 1998; Csikszentmihalyi, 1990), increasing curiosity levels in students (Lepper, 1998), providing authentic learning opportunities (Bruner, 1966), giving feedback as learners progress toward a goal (Lepper, 1998), allowing students some control or self-determination, (Lepper, 1998), and enhancing students' self-efficacy

through providing opportunities for success (Alderman, 2008). Alderman (2008) explains how although "telling a student 'you can do it' is a widely used strategy, the effect on increasing efficacy expectations is likely to be weaker than feedback that comes from direct or vicarious experience" (p. 73). For example, a student can be told they can learn to play an arpeggio, but actually playing an arpeggio has more influence on whether they feel able to take on the task.

If learners find tasks interesting, they will be intrinsically motivated to engage in them (Blumenfeld, 1992). One role of gamification, then, is simply to present learning tasks in ways that students are likely to find interesting. Alderman (2008) provides a list of strategies for increasing interest level in tasks in a classroom: a) provide students with a choice of topics and activities to engage in, and with a choice of ways in which they can demonstrate their learning, b) use various instructional techniques including the incorporation of illustrations and analogies, c) help students make connections to their existing knowledge, and ask them to apply what they learn, d) push students to justify their answers, consistently evaluating to check to understanding, e) frame questions so that the entire class can answer, for example, through voting on answers, d) scaffold learning, through the use of examples, modelling, and encouraging collaboration, and e) allow students to repeat assignments and tests until they have achieved learning goals (p. 242). While these examples are given for classes with multiple students, they are also applicable to teachers and students relating one-on-one in a private music lesson.

Dreeben (1968) proposed that it is "crucially important for students in school to be

occasionally forced to complete projects in which they have no particular interest and for which they have no particular aptitude" (p. 42). Whether or not this is crucially important, it is likely necessary. For students who do not naturally enjoy practicing technical elements, or for those who find them a great challenge to play, extrinsic motivation has unique value; it can be used as a sort of spark to ignite intrinsic motivation (Lepper, 1988). Students may be lacking intrinsic interest only because they have misjudged the nature of a task, or incorrectly assumed that they do not have the ability to do the task. Once an extrinsic motivator prompts them to approach a task, that motivator may gradually be withdrawn as the learner begins to acquire knowledge about how to perform the task, and gains the self-assurance that they can succeed at the task (Lepper, 1998).

Based on the review of the existing literature, gamification in the context of private piano study is a timely, distinctive topic for study. Gamification, as a relatively new phenomenon, is a propitious topic for consideration as a potential student motivator; it continues to make inroads into increasingly more situations such as government programs to encourage recycling, vehicles that display dashboard graphics of a plant growing in coordination with responsible driving, and mobile and web applications that reward and broadcast healthy eating and exercise habits. If gamification is to similarly pervade the educational landscape, research concerning how to effectively implement it is crucial. As suggested by Fu, Su and Yu in 2009, learners today, for whom rapid technological change is commonplace, already assume that games will be included in their learning environment. While games designed to teach musical knowledge and skills are prolific and include popular examples such as MusicAce and Rock Band for Wii, this

study, in contrast, brings the world of game playing into the context of private piano lessons.

CHAPTER 2: METHOD

This research study took place over a 9-week period in the fall of 2012. All of the participants were familiarized with the nature of the study at their Week 1 piano lesson when the teacher read a description from a script (see Appendix A). This script structured and standardized the initial experience of the study for all participants. Two unique versions were used: one for the control group and one for the experimental group. During Weeks 2 through 9 of the study, data were collected in order to determine the effects of gamification on student motivation to practice technical exercises outside of lessons. All procedures were conducted in accordance with University of Toronto ethical review protocol 28065.

Variables

This 9-week study measured students' motivation to practice technical exercises on the piano. Notably, it did not track the amount of time students practiced, since this is done outside of lessons and is difficult to determine with accuracy. Instead, students' motivation to practice was measured by the number of technical exercises mastered, on the assumption that mastery of an exercise can be attributed to repeated practice of that exercise (Ericsson, 1993). In a study of instrumental music students by Schmidt (2005), musical achievement was shown to correlate significantly with motivation. In order to

measure student motivation to practice, then, achievement levels were used as the indicator; in addition, to broaden the picture of student motivation in the context of the study, the attitude and self-efficacy levels of participants were also measured. The primary independent variable was *type of instruction*, with participants being divided into two groups of 10 students each. Group 1 (Control group) practiced technical exercises in a nongamified environment, while Group 2 (Treatment group) had gaming techniques implemented in relation to their practice of technical exercises. Potential covariates considered were *gender*, *age*, *amount of experience as a piano student*, and *studio*.

Participants

The participants for this quasiexperimental study were recruited from students aged 7 through 17 among the piano students of the researcher and the piano students of teachers in the local branch of the Ontario Registered Music Teachers' Association (ORMTA). The age range specified is the typical range found at most private piano studios where students are engaged in studying the Royal Conservatory of Music (RCM) graded curriculum.

The RCM was chosen as a common curriculum base from which participants would be recruited since it is a typical standardized method for which large numbers of music students prepare and complete examinations. Widespread, highly respected instructional programs like the RCM are valued "by many in the profession who use them as an indication of a developing child's musical ability" (McPherson & McCormick, 2006, p. 322). The RCM curriculum is also ideal for the context of this study since it specifies a

sequential order in which technical exercises should be learned, detailing which keys and exercises should be mastered at each grade level.

An email invitation was sent to all teachers in the local ORMTA branch, asking them if they were willing to assist with recruitment of piano students as well as data collection for the study. One teacher who agreed to participate was asked to provide her students and their parents with prepared letters of invitation that indicated the purpose of the study and asked parental permission for each child to participate in study tasks. Once she had recruited a number of her students, this participating teacher fully engaged in data collection procedures involving her students in both the control and experimental groups.

The method of randomly assigning participants to the control group and the experimental group was done by counterbalancing piano studio, and experience playing the piano. It should be noted, however, that participants from the same family were placed in the same group to avoid the tension or confusion that could arise within a home if one family member was in the control group, and one was in the experimental group.

The participants were 14 females and 6 males aged 7 to 17 years ($M = 11.3$, $SD = 2.64$). For the purpose of creating three groups of comparable size, participants were categorized into three developmental groups, age 7-10, age 11-13, and age 14-17. The study began with 21 participants, 11 from the studio of the researcher (Studio A), and 10 from the studio of the participating piano teacher (Studio B). One participant from Studio B withdrew from the study during Week 4, leaving 20 participants in total. The piano-playing experience of the participants ranged from beginner to advanced piano players,

with 8 participants in the Beginner Category (Preparatory - Grade 1), 6 participants in the Early Intermediate Category (Grades 2 – 4), and 6 participants in the Advanced Category (Grades 5 – 9).

Procedure

Group 1 (Control)

Participants in Group 1 were assigned one key at each lesson, and were expected to practice all the technical exercises required for that key for 1 week. At the following week's lesson, the student was asked to play those technical exercises for the teacher, who used the Performance Measure Rubric (See Appendix B) to determine whether mastery was achieved for each technical element. For example, a participant studying at the Grade 4 Royal Conservatory level might receive the following written instructions at their lesson:

"This week, practice technique in the key of D major.
The required technical exercises are:
Scale, hands together, two octaves
Staccato scale, hands separately, two octaves
Chromatic scale, hands separately, one octave
Solid and broken triad and inversions, hands separately, two octaves
Solid and broken triad and inversions, hands together, one octave, with cadence
Arpeggio, hands separately, two octaves"

During Week 1 or Week 2 of the study, a message was sent to the contact email address that each Group 1 participant had provided. This email message contained a link to an exemplar video, demonstrating how the required technical exercises for their grade level were to be performed. An example can be viewed here: http://www.youtube.com/watch?

v=5sTcSRi6aJo&feature=plcp. If students achieved mastery in any or all of the technical exercises they had practiced throughout the week, the teacher provided positive verbal feedback and surreptitiously recorded the results; the teacher then asked the student to move on to another key for the next week. If the student did not achieve mastery in all the exercises, that same key was assigned for another week. After 2 weeks, whether full mastery was achieved or not, a new key was assigned.

Group 2 (Experimental)

Group 2 received the experimental version of technical exercise instruction, i.e. gamification. During Week 1, participants were introduced to the game *Technique Tower.* See Figure 2 which illustrates a screenshot of a game webpage, or visit a live game webpage here: http://www.techniquetower.com/p/missy.html. The goal of *Technique Tower* is to reach the top of the tower by "climbing" up each of its 7 levels. This is done through mastering a designated number of technical requirements for the appropriate grade level, according to the Royal Conservatory of Music graded curriculum specifications. Game players were given a comprehensive chart detailing all of the specific technical requirements for their grade level, an example of which is shown in Appendix C. These participants were also sent links to the relevant exemplar videos. Players were encouraged to choose any technical element to work on at any time, in any order. When they demonstrated mastery of any technical element, the piano teacher declared that they had received 10 points. Their game webpage was then updated to reflect their point total; a certain number of points resulted in beating a level, for which a virtual trophy was earned.

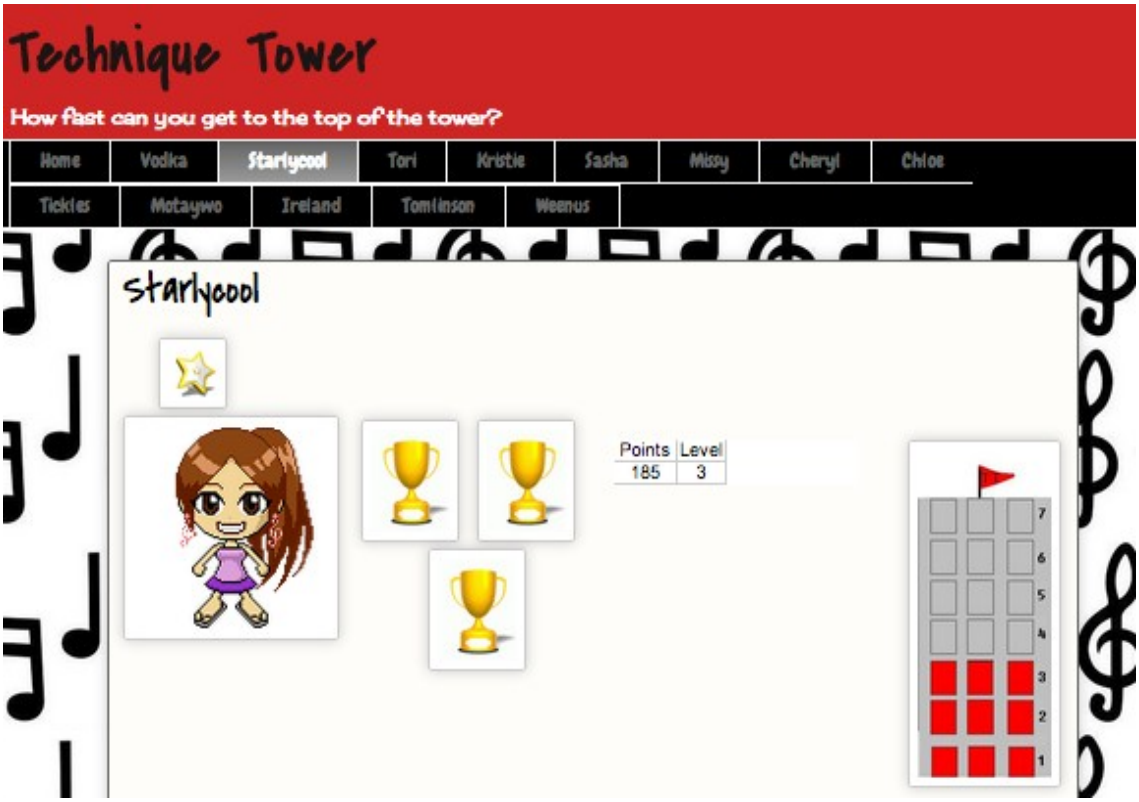

Figure 2. Screenshot of a *Technique Tower* webpage – Alias "Starlycool." Retrieved from: http://www.techniquetower.com/p/starlycool.html.

Table 1 details the unique number of points which players in each RCM grade level need to earn in order to beat each level, and eventually reach the top of Technique Tower.

Table 1

Requirements for Beating Levels in the Game, "Technique Tower"

Grade	# of Technical Elements to Master to Beat a Level
Preparatory	3
Grade 1	4
Grade 2	4
Grade 3	5
Grade 4	6
Grade 5	7
Grade 6	8
Grade 7	9
Grade 8	10
Grade 9	12

The reason for requiring students in higher grade levels to achieve more points to win the game was simply that there are more technical requirements for higher RCM grade levels. Since the game was not a race to reach the top, but rather an individual pursuit, it was thought appropriate that players in different grade levels would spend varying amounts of time working toward mastering technique, beating levels and finishing the game. According to RCM expectations, the higher the grade level, the greater the amount of time needed to spend practicing technical exercises, due to increased length and

difficulty.[1]

All Group 2 participants had their own web page featuring an avatar they created and an alias they chose. The webpage listed the points they had achieved, as well as whether they were on Level 1, 2, 3, 4, 5, 6, or 7. Once participants mastered a technical exercise, using a mobile application called SoundCloud, an audio recording of that exercise was made and uploaded to the player's web page for parents, other students, teachers, and members of the public to listen to and comment on (see Figure 3).

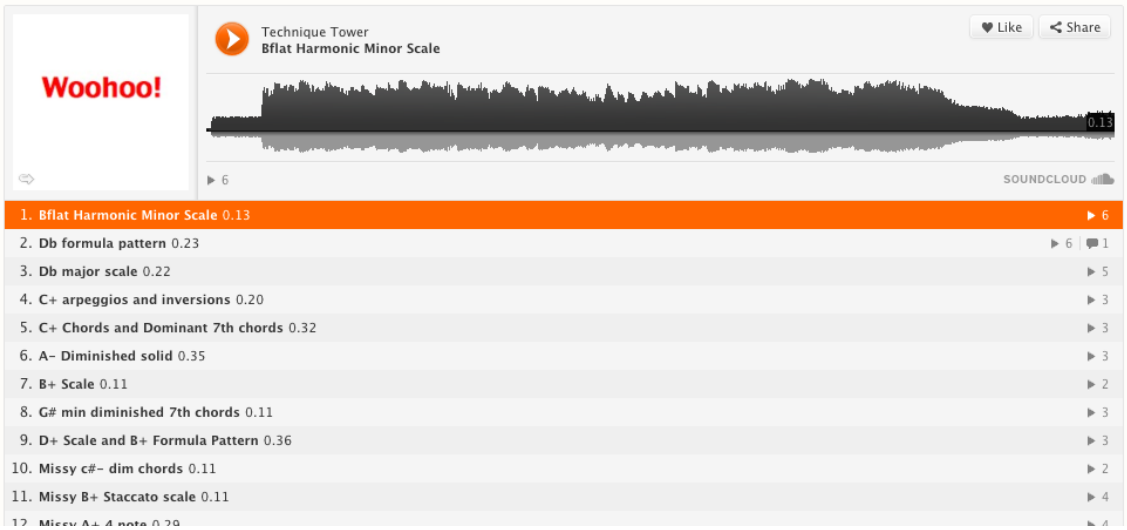

Figure 3. Playlist of technical exercises a player has mastered embedded on her webpage. Retrieved from http://www.techniquetower.com/p/missy.html. Used with permission.

[1]The scoring system for *Technique Tower* had originally been designed to reflect that a player who reached the top of the tower had mastered every single technical element required for that grade level. However, a few weeks into the game, it became clear that participants in higher RCM grades found it unfair that they had more work to do to earn points and beat levels than players in lower RCM grades. The scoring system was then adjusted to allow participants to beat levels and reach the top of the tower without having mastered every single technical element required for the RCM grade. The requirement for players in higher grades to master more exercises per level was retained, in order to reflect an appropriate and comparable workload for each RCM grade level.

When players beat a level, they received a virtual trophy on their web page and an emailed message of congratulations, along with a link to their game webpage for easy click-through to view their progress. Bonus stars, another type of achievement awarded via email, were given to players if they demonstrated transfer of learning such that their skill in a particular technical exercise contributed to their success in another context such as playing a piece, or sight reading. For example, if a student mastered the D minor arpeggio, and then encountered an A minor arpeggio excerpt within one of their pieces and played it without hesitation, this deserved a Bonus Star. The shape and fingering pattern for these two arpeggios is similar, and so the practice of the one correlates with the success of playing the other. Students also received Bonus Stars for other impressive musical achievements. They were intended to surprise students for any reason of the teacher's choosing, which the teacher took note of on the Mastery Record sheet.

Instrumentation and Data Collection

Approval from the appropriate ethics board was gained (see Appendix D), and then informed consent from each participant and participant's parent was sought before any data were collected. The instruments used to collect data in this study included a Mastery Record Sheet (guided by a Performance Measure Rubric), a Self-Efficacy Measure, an Attitudinal Measure, a Teacher Interview Protocol, and an Online Interview Protocol. The text and audio comments left on the *Technique Tower* web pages throughout the period of the study were also considered to be collectable and analyzable data.

Mastery Record Sheet (See Appendix E)

This is the recording sheet that teachers used to keep track of student progress throughout the 9-week study. During Week 1, the students' assigned ID number, gender, age, Royal Conservatory grade level, and email address were recorded here. During Weeks 2 through 9, teachers recorded which technical exercises students played for them, along with the total number of points awarded. For Group 1 participants, the key assigned for practice each week was also written down. For Group 2 participants, the point total each week was entered into an online spreadsheet which automatically updated each player's webpage to reflect their achievement.

Performance Measure Rubric (See Appendix B)

A rubric was used to help assess whether students had achieved mastery on each technical exercise. This rubric was designed in consultation with three other music teachers in order to help establish content validity. Ideas were pooled in order to come up with a comprehensive list of characteristics which would comprise mastery. The rubric provides clear direction for students needing to know how to achieve mastery, and a reference by which teachers could decide how many points to award to a participant. The development and use of this rubric was crucial for ensuring consistency since data were collected by more than one person. The two teachers who used the rubric as a scoring tool first discussed each aspect to ensure common understanding, and agreement about the significance of each requirement for mastery.

While collaborating to create this measure, the teachers involved defined three levels according to which a student performance could be rated. For Group 1, these levels were

named *Still Working on It*, *Getting There* and *Got It*. For Group 2, the same three levels were called *Recruit*, *Veteran*, and *Master,* to represent more game-like category names. These three achievement levels (AL1, AL2, and AL3) allowed teachers to award 5 points to a student who performed a technical exercise at AL2, and then another 5 points to that same student when they raised their performance quality up to AL3. In contrast to waiting until students achieved mastery to award a full 10 points, this scaffolded scoring method increased the number of goals players could work toward in the game, and increased the frequency at which they would be awarded points.

Self-Efficacy Measure (See Appendix F)

This measure was used pre- and post-study, during Week 1 and again during Week 9. Student participants filled out this questionnaire to indicate their feelings and beliefs about their ability to learn to play technical exercises through practice. This Likert scale questionnaire was based on a tool developed by Ritchie and Williamon (2011) known as the "Self-Efficacy for Music Learning Scale." A scale to measure self-efficacy was chosen since, in musical education research contexts, self-efficacy has been connected with levels of persistence and levels of achievement (Eccles, Wigfield, Harold, & Blumenfeld, 1993; Schmidt, Zdzinski, & Ballard, 2006). When tested, Ritchie and Williamon's 11-question scale was shown to have internal consistency, as well as to effectively confirm a single underlying factor, through the process of factor analysis (Ritchie & Williamon, 2011). It was administered twice to the same participants within a period of nine months, and consistent scores demonstrated its reliability (Ritchie & Williamon, 2011). Permission from the authors was obtained to use the scale with small

changes made to reflect the unique context of this study, that is, learning to play technical exercises.

Attitudinal Measure (See Appendix G)

This online questionnaire which was administered at the end of the study, during Week 9, featured ten statements which participants responded to by choosing from five-point Likert scales. The statements were developed by the researcher, who invited feedback from other music teachers regarding their potential to effectively gauge students' attitudes toward practicing technique. A consensus was reached concerning the questions on the scale, and their ability to provide insight into student attitudes.

Online Interview (See Appendix H)

During Week 9 of the study, participants in the treatment group were interviewed by way of an online questionnaire. The ten questions were designed to elicit information from the game players to determine the nature of their experience in the gamified environment. They were asked to describe the range of feelings they experienced throughout the playing of the game, and then to rate the game in the areas of fun, fairness, and effectiveness. They were also invited to comment on various aspects of the game.

Teacher Interview Protocol (See Appendix I)

This instrument was designed to collect information from the participating teacher in the study. The interview was conducted in two parts, Part 1 (Questions 1-6) during Week 1 of the study, and Part 2 (Questions 7-10) during Week 9. Part 1 questions were designed to gather information about the values, beliefs, and practices of the participating teacher in

regard to the teaching of technical exercises. It was anticipated that if the participating teacher and teacher-researcher held distinct values and used distinct strategies for motivating students, this could have an affect on the achievement levels of their students throughout the study, thus becoming a confounding variable. Part 2 questions were asked to allow the participating teacher an opportunity to mention any interesting phenomena she noticed, to comment on any facet of the study, or to give ideas for further research. While there is only one official researcher in this proposed study model, the other participating piano teacher was invited to contribute insights from her own unique perspective through which she experienced the research method and data collection process.

CHAPTER 3: RESULTS

This chapter summarizes results from the analyses which were conducted to answer the research question of the study: Does gamification affect students' motivation to practice technical exercises such as scales, chords, and arpeggios within the private piano lesson environment? The chapter begins with the participants' demographic information indicating gender, ages and experience levels. Then the inferential analyses, for which an alpha level of .05 was used to establish statistical significance, are outlined. These quantitative analyses provide answers to the following subquestions: 1) Does gamification affect the self-efficacy levels of piano students? 2) Does gamification affect the attitude of piano students towards practicing technique? 3) Is gamification perceived as an enjoyable and effective motivator?

Mastery of Technical Exercises

The hypothesis that the participants in the experimental group, as a result of the gamification environment, would master more technical exercises in a 9-week period than the participants in the control group, was tested. It was recognized that students in higher RCM Grade levels would need to master more exercises per week than those in lower grade levels, in order to learn all the exercises required within the typical one year of piano study per grade. This recognition, along with the consideration that students in

higher grade levels have more experience playing technical exercises, led to the decision that a set of comparable, proportional achievement scores should be computed. Both the teacher-researcher and the participating teacher in the study agreed upon a Teacher Expectation Score (TES) unique to each of the three levels in the variable, *experience,* such that Beginner students were expected to master two technical exercises each week, Intermediate students were expected to master three, and Advanced students were expected to master four. This TES was divided by the actual number of technical exercises mastered each week, generating a weekly proportional score for each participant.

The Mann-Whitney *U*-test was chosen to compare the difference in the achievement scores between the groups, since it is well-suited for use with small sample sizes, i.e., 5 to 20 participants (Nadim, 2008). Proportional achievement scores for the experimental group (*Mdn* = .99) were higher than for the control group (*Mdn* = .32). A significant effect of group was found, with the mean rank of the Control Group being 6.4 and the mean rank of the experimental group being 14.6; $U = 9.0$, $p = .002$. Figure 4 illustrates the total number of exercises mastered by each group, showing that gamification does have a positive effect. Specifically, this result suggests that when piano students learn technical exercises in a gamified environment featuring an online social context, points, levels, and achievements, they master more exercises than those who are not in a gamified environment.

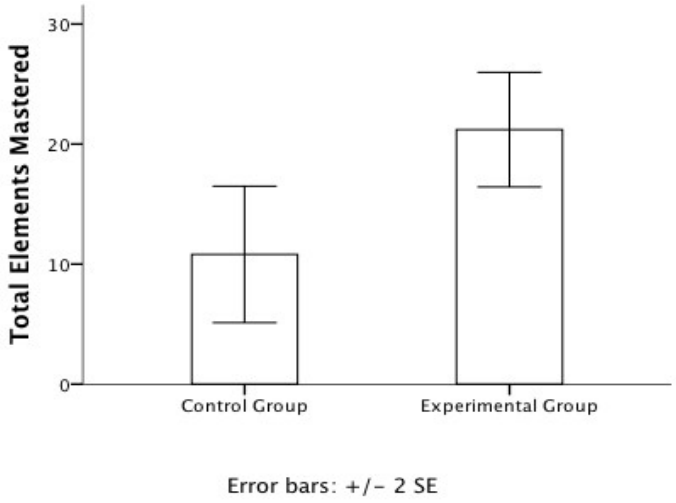

Figure 4. Achievement scores showing the number of technical exercises mastered.

Point-biserial Pearson correlations were conducted to determine if the variables *gender* or *studio* were related to the number of technical exercises that participants mastered. The working hypothesis regarding these potential covariates was that they might, in fact, correlate with the number of exercises achieved. For *gender*, participants were coded as either male or female; for *studio*, participants were coded in two separate groups representing the two different piano teachers from whose studios they came. No significant relationship was indicated between *gender* or *studio* and the achievement scores of participants in the control and treatment groups, as illustrated in Table 2.

Table 2

Correlations between number of exercises mastered and potential covariates.

Interaction	Control[a]		Treatment[b]	
Proportional score x	r value	p value	r value	p value
gender	-0.34	0.337	-0.34	0.345
studio	-0.22	0.536	-0.03	0.936

[a]n = 10. [b]n = 10.

No significant correlation with regard to *gender* among the control and treatment groups suggests that achieving mastery of technical exercises is equal among male and female piano students. The result that *studio* showed no correlation allows this analysis and the following discussion to proceed on the assumption that even though the participants came from two different piano studios and had different piano teachers, they can be considered as one homogeneous sample group of piano students. This assumption coincides with the data collected using the Teacher Interview Protocol. During the interview, the participating teacher expressed her views about technique and described her usual methods for motivating students to practice; her views and methods were found to be similar to those of the teacher-researcher. Both teachers placed a high priority on technique as an integral part of learning to play the piano. When asked to describe her feelings about students practicing technical exercises such as scales, chords and arpeggios, the participating teacher's answer echoed the perspective described in the

Introduction section: “It's a necessity; it's part of taking lessons that gives you the skills, tools, and ability to play the pieces you want to play. If you want to play Fűr Elise, you'll have to know how to play all the arpeggios and chords in e minor. [My students] don't have an option. I don't present [technique] as a negative or a positive thing. I just present it as: this is how you learn to play.”

The variables *age* and *experience* were also hypothesized to not have an affect on achievement scores. To test this assumption, a Kruskal-Wallis one-way ANOVA was performed on the results from the three age groups, as well as the three experience groups. For *age*, no significant effect was discovered in the control group $F(2, 10) = 2.24$, $p = .326$, nor in the experimental group, $F(2, 10)$ 2.42, $p = .299$. *Experience* also showed no significant effect in the control group, $F(2, 10) = 1.67$, $p = .435$, nor in the experimental group, $F(2, 10) = 2.42$, $p = .299$. These results suggest that gamification has a similar effect on achievement levels among piano students of various ages and experience levels.

Gamification and Self-Efficacy

To test if gamification had an effect on piano students’ self-efficacy, a questionnaire was administered to participants twice, once at the start of the study, T_1, and again at the end of the study, T_8. The survey, modelled closely after the Self-Efficacy for Music Learning questionnaire developed by Ritchie and Williamon (2011), had 11 questions, and required participants to provide responses on a 7-point Likert scale. Participants' responses were summed to calculate an initial SEML (Self-Efficacy for Music Learning) score for each

participant at T_1, and a follow-up SEML score at T_8. If gamification could uniquely affect self-efficacy in a positive way, then a raised SEML score at T_8 for the experimental group would be expected, while the SEML score at T_8 for the control group would be projected to remain the same. Or perhaps both the experimental and control groups would score higher on SEML at T_8 due to the maturation effect, but the experimental group would indicate substantially higher self-efficacy levels. A paired samples Wilcoxon rank sum test was conducted to determine if there was an effect on self-efficacy scores over the time period of the study. The analysis revealed that within the control group, participants' SEML scores decreased marginally over time, with the mean rank at T_1 being 6, and the mean rank at T_2 being 3, $z = -.84$, $p = .400$. But the SEML scores of the treatment group also failed to indicate a statistically significant change from T_1 to T_8, $z = -.26$, $p = .798$, with the mean rank at T_1 being 5 and the mean rank at T_2 being 6. Since SEML scores remained fairly consistent throughout the period of the study in both groups, this suggests that gamification did not have a significant effect on the self-efficacy of piano students, as hypothesized (see Figure 5 & Figure 6).

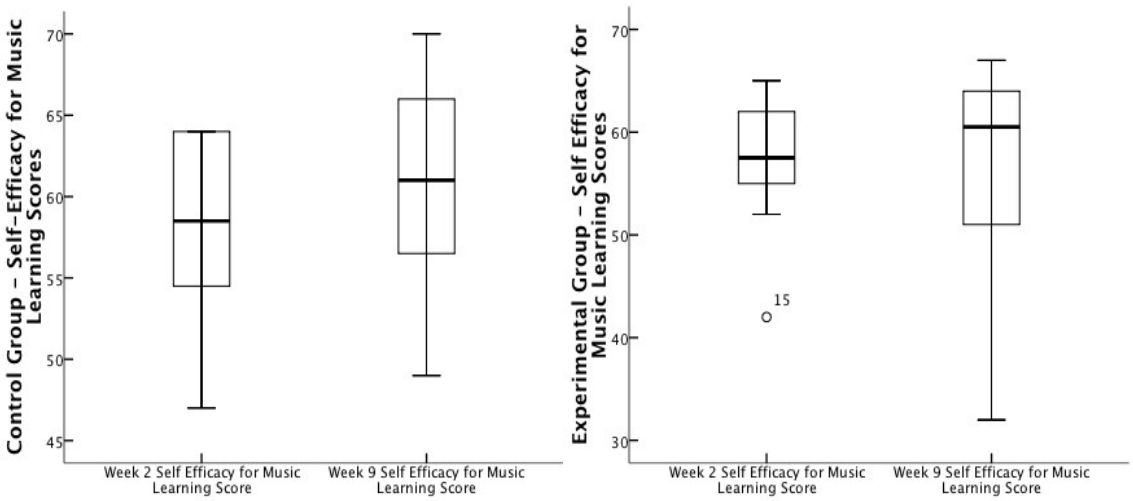

Figure 5. Self-Efficacy scores of Control and Experimental Groups at Week 2 and Week 9.

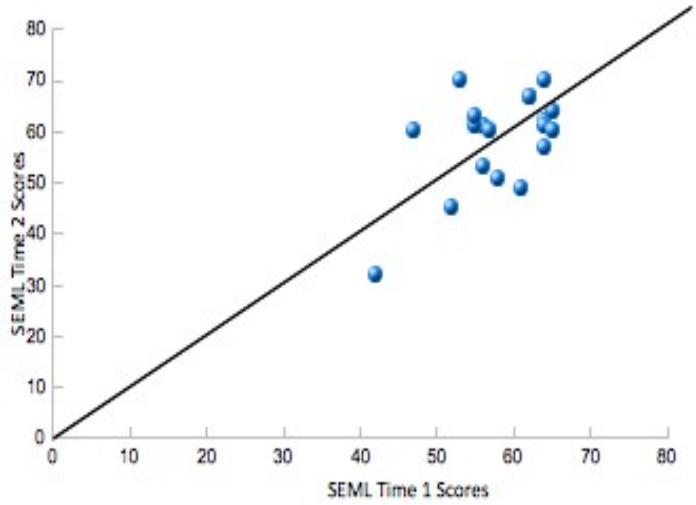

Figure 6. Comparison of self-efficacy scores of each participant at Time 1 and Time 2.

Another hypothesis related to the SEML scores of participants was that SEML scores would positively correlate with their achievement scores. Spearman correlations were conducted to test whether there was an interaction between participants' final SEML score at T_8 and the sum of their proportional achievement scores. No significant

correlation was discovered between the mean SEML score of the control group and their achievement score, $r = -0.07$, $n = 9$, $p = .821$. Nor was any significant correlation discovered between the mean SEML score of the treatment group and their achievement score, $r = -0.34$, $n = 10$, $p = .337$. In other words, self-efficacy was not shown to be positively correlated with how many technical exercises the piano students mastered. The self-efficacy levels of all the participants in this study remained consistent throughout the 9-week period, regardless of the fact that the treatment group achieved mastery on a significantly higher number of technical exercises.

Gamification and Attitude

To determine whether gamification had an effect on attitudes toward practicing technique, Likert scale data were collected at T_8 and summed to represent each participant's attitude (ATT) score. A Wilcoxon signed rank test was performed to compare the ATT scores of the control and treatment group, assuming that if gamification had an effect, a significant difference would be detected. However, the test did not show a statistically significant difference between the ATT scores of the control and experimental groups. A marginal effect was indicated, with the mean rank for the Control Group being 7.9, and the mean rank for the Experimental Group being 11.1, $z = -1.29$, $p = .198$. A visual comparison between these attitude scores is depicted in Figure 7.

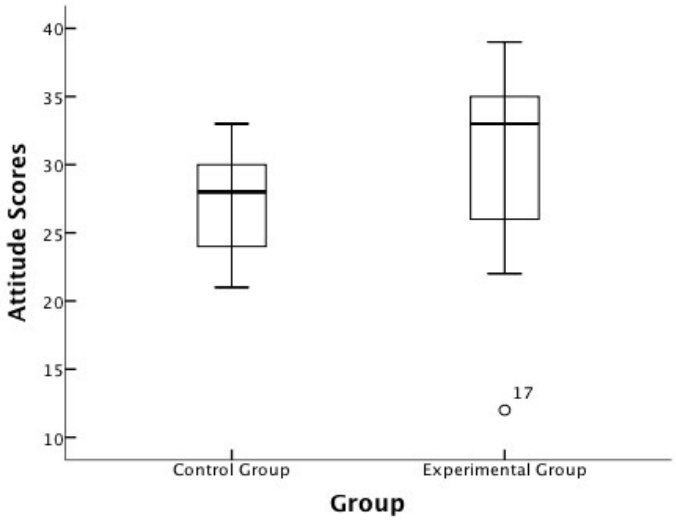

Figure 7. Mean Attitude Scores for Control and Experimental Group.

The Experience of Gamification

To assess whether the experience of playing the game *Technique Tower* was perceived to be enjoyable and effective by the players, an online interview was conducted. This interview was optional for the ten participants in the treatment group, of whom eight chose to participate. Positive comments about the game written by players included, "I LOVE teqnice [*sic*] tower!!!!! :)", and "This game is really fun i like it." Table 3 shows all the comments that participants chose to contribute.

Table 3

Participants answered the question, "Do you have any comments about the game?"

Responses
This game is really fun i like it.
I like it because it motovates [sic] kids to practice more
Some comments i have are that...I think this game is a fun and edgecational [sic] for people to practice and achieve our goal/level. I hope this game will last forever!!
IT RULES and I love it!

One of the interview questions invited participants to give *Technique Tower* a fun score, a fairness score, and an effectiveness score, out of ten. Table 4 shows the results of these ratings.

Table 4

Ratings of the game, "Technique Tower" by players

Fun Score*	Fairness Score*	Effectiveness Score*
8	7	9
6	8	6
3	3	5
7	9	10
10	8	10
7	9	8
10	9	9
8	10	6

* Scores are out of 10.

The mean fun score was 7.67 out of 10, *SD* = 2.29, the mean fairness score was 8.00 out of 10, *SD* = 2.06 and the mean effectiveness score was 7.75 out of 10, *SD* = 1.83. While it has already been established that the variable *studio* did not have an effect on participants' achievement scores, Pearson correlations were conducted to determine if there was a relationship between the variable *studio*, and the way players rated the game. *Studio* was carefully observed since half of the game players had never met the game creator, while half of them were piano students of the game creator. It was assumed that if no significant correlation between *studio* and game ratings was found, the ratings could be acknowledged as true representations of the players' opinions. One of the eight respondents to the online interview chose to remain anonymous, so it is not known which piano studio that person's responses represent. Analyzing the other responses revealed no significant correlation between *studio* and *Technique Tower* ratings, $F(6) = -.45$, $p = .367$. From this result, it can be accepted that the participants from the studio of the game creator were not influenced by the desire to please their piano teacher in such a way that their ratings were inflated beyond expected levels.

Interviewees were asked to select which of the following emotions, if any, they felt when they received points, beat a level, or earned a trophy in the game: *happy, powerful, safe, selfish, strong, confident, greedy, sad, confused, competitive, excited, or angry*. *Happy* was mentioned 17 times, followed by *excited,* 10 times, *confident,* 8 times, *competitive*, 5 times, and *strong*, 4 times. *Proud* and *powerful* were also mentioned once each. Other comments about the game are included here in Table 5.

Table 5

Participants were invited to finish the sentence: "When I get to the top of Technique Tower:"

Responses
I learned a lot and it has been really fun
I am proud
I will still have a lot of work to do before my exam
I will feel like I know a lot of my scales and my chords, and have done so much and know so much. As soon as you've got the chords and the scales you can play songs a lot easier.
I will be very proud of myself for practicing a bunch.
I'll be proud that I practiced a lot.
I will say I am king of the tower!!!!!!!!!! :)

One aspect of the game which was rated negatively by most interviewees, was the game character, Technique Turkey (see Figure 8). This talking cartoon turkey was featured in weekly emails to game players, reminding them to practice technique, and encouraging them as they beat levels in the game and moved up *Technique Tower*. Participants were asked whether the messages from the turkey actually reminded them to practice technique. While one respondent said yes, the rest answered with *sort of*, *not really*, or *sometimes*. Two participants had never heard of Technique Turkey, while one said she tried to listen to the message from Technique Turkey every week, but when she clicked on the link to hear the message, nothing happened. One player joked that the reward for getting to the top of *Technique Tower* might be a roast turkey dinner, while two other players commented that the voice of the turkey was "creepy."

Figure 8. Screenshot of the talking avatar, Technique Turkey. Retrieved from: http://www.voki.com. Used with permission.

One interviewee who indicated she felt happy, excited and powerful when she earned points also expressed the following sentiment when asked about the effectiveness of the game for getting students to practice technique: "It's sort of not a good way to get them to practice because you don't actually get the real trophies." A follow-up question about whether she would practice more if she got real trophies elicited a bold "Yes!" Another scenario which revealed somewhat of a juxtaposition occurred when the first player successfully reached the top of *Technique Tower*. After practicing a lot to master each technical element required for her grade level at a rate faster than the other nine players, she was invited to play again to help motivate her to practice the technical requirements for the following grade level. She declined and said she would rather just practice the next grade level technique in the regular way, instead of playing *Technique Tower* again. When asked why, she said she was not sure.

Before the study began, it was thought that another rich source of data that could provide insight into how gamification affects piano students' experiences of the game would be

the text and audio comments that were left on their webpages. It was anticipated that these comments would be left in response to their achievements such as points, trophies and stars, and in response to the recordings of them performing technique. However, very few comments were posted on the players' webpages. One player did use the comment feature on her webpage to register two complaints about the game. The player wrote: "I don't understand why I have more points than other students, yet I'm at a lower level. I have to work harder on each technical requirement, they have to be faster and each one is much longer. Also, I have done 14 master technical requirements and only have 205 points." The first two sentences here describe her frustration at the game being unfair. The last sentence indicates her disappointment upon checking her webpage and discovering that it had not yet been updated to reflect her current points and trophies earned. The implications of these findings, along with a discussion of all the results reported here, will be addressed in the following chapter.

CHAPTER 4: DISCUSSION AND CONCLUSION

The main purpose of this study was to find out if gamification affects piano students' motivation to practice technical exercises. As discussed in the Method section, student motivation was measured by tracking achievement, since motivation to practice a musical instrument is closely linked with achievement levels (Schmidt, 2005). Gamification was found to have a significant positive affect on the number of technical exercises students mastered. Students' self-efficacy levels and attitude toward practicing technique were also measured. While self-efficacy levels were unaffected by gamification, attitude toward practicing technique had a moderate positive affect.

Mastering technical exercises is crucial, as described in the Introduction; ideally gamification would also positively affect self-efficacy levels and students' attitude toward practicing technique. In other words, optimal conditions would see gamification positively affect both the extrinsic and intrinsic motivation of piano students. Extrinsic motivation, in the context of this study, is reflected by achievement scores. *Technique Tower* was used to motivate students extrinsically by giving them opportunities to demonstrate their skills to their friends and family, and to the world, online; the game provided a goal-setting atmosphere where players earned trophies and bonus stars. Demonstrating their skills and earning rewards gave players the chance to receive

accolades from other players in the game, their teacher and family. Considering intrinsic motivation within the study environment, the self-efficacy and attitude measures are indicators. *Technique Tower* provided fun, enjoyment, and feelings of accomplishment for students. Following is a discussion of the successes and failures of *Technique Tower* to facilitate both extrinsic and intrinsic motivation in piano students.

Increased Motivation and Achievement

Clearly, gamification had a positive effect, with students in the experimental group attaining mastery of significantly more scales, chords, and arpeggios than those in the experimental group. This research suggests that the use of gamification is an effective method for motivating piano students to practice technique. These findings concur with studies in other learning contexts about games and their ability to influence student motivation and student learning (Shin, Sutherland, Norris & Solway, 2012; Burguillo, 2010). Due to this finding, after the 9-week period of the study was complete, the gamification experience was also offered to the students in the control group so that they might experience the same potential benefit.

The *Technique Tower* website was designed as an online environment that tracked students' mastery of technical exercises and shared their accomplishments with them and their families. Each game webpage displayed a player's username and avatar, along with their current point total, level, and earned bonus stars and trophies. In addition, the webpage functioned as a hub for collecting artifacts that represented players' progress. Some of the game elements which were part of *Technique Tower* that may have

contributed to increased achievement levels in players include story, replayability, recognition, social context, and control.

Story

Admittedly, the game used in this study did not feature any tension and resolution, two crucial ingredients of story. However, it did feature characters, a simple plot, and a conclusion. Each game player was represented online by a character which they named and designed using an avatar creation website, http://www.moeruavatar.com/index_en.shtml. Some of the avatars designed by the players in this game appear in Figure 9. Each of these game characters began at the bottom of *Technique Tower* and gradually climbed up by earning points and beating levels in the game. Figure 10 shows *Technique Tower* with varying degrees of achievement depicted; the ultimate goal of the game was to beat all seven levels and reach the top of the tower.

Figure 9. Selection of avatars designed for the game, *Technique Tower*. Retrieved from http://www.moeruavatar.com/index_en.shtml. Used with permission.

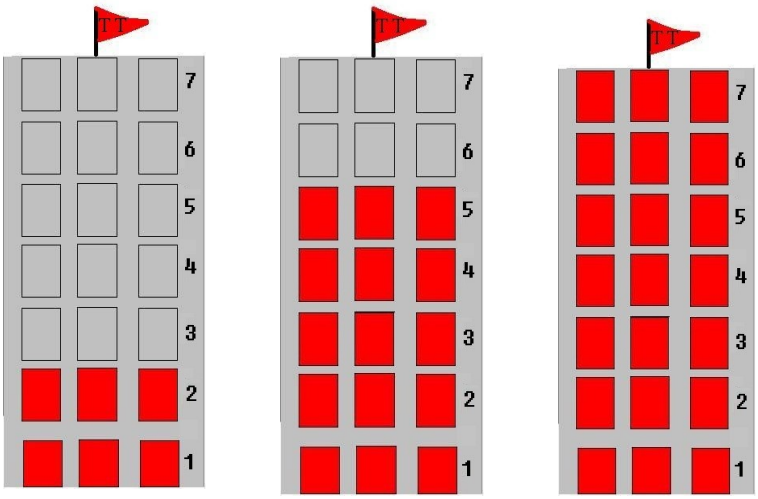

Figure 10. Three iterations of technique tower depicting various levels achieved.

Replayability

Technique Tower players spent time practicing technical exercises; they tried to earn points for mastering each exercise by playing it for their piano teacher during the first five minutes of each lesson. Realistically, this short time period was not long enough for a player to repeat a scale an unlimited number of times. However, players did not demonstrate mastery on the first try they could continue practicing it at home, and play it for the teacher each week until they achieved mastery and earned points.

Recognition

Technique Tower rewarded players with 10 points for each technical exercise they mastered, and a certain number of points resulted in the earning of a virtual trophy. The point score and number of trophies for any player could be viewed on their webpage which tracked their progress in the game. Weekly email updates about players' progress were sent as notifications and reinforcements of the rewards given. While players could

compare their personal progress with others' in the game, all players had the opportunity to “win” the game, or to complete the game by achieving the maximum number of points and reaching the top of the tower.

Social Context

While collaborating with other players to overcome obstacles was not part of *Technique Tower*, the social context of the game was provided by the online webpages which tracked players' progress, and provided opportunities for visitors to leave audio and text comments. This online context shifted the students' achievements from the confined environment of a one-on-one piano lesson to an open platform, accessible by anyone, but in particular by the students' family and other students in the studio. While crossing paths between piano lessons, game players were heard discussing their progress with fellow students, and eagerly showed their webpages to one another, using their phone or ipod.

Control

Technique Tower supported autonomy and student control over choices by encouraging players to learn to play technical exercises in any order. While a nongamified approach to learning technical exercises is often sequential and directed by the piano teacher, the gamification environment in this study gave control to the student, in an effort to encourage ownership and decision-making.

Scaffolding

All *Technique Tower* players who mastered a technical exercise received 10 points. To

provide more frequent opportunities to earn points, it was also specified that players who had obviously practiced an exercise, but were not quite at mastery level, could earn five points. At a subsequent lesson, when those players demonstrated mastery, they would earn the other five points, for a total of 10. Maximizing accessibility to point-earning correlated with the importance of clear, attainable goals as defined by flow theory, (Csikszentmihalyi, 1990), and with the importance of extrinsic motivation as outlined in expectancy-value theory (Pintrich & Schunk, 1996). In addition, certain students, based on their piano playing experience level, or on physiological factors, would have found it extremely difficult to achieve mastery of a number of technical exercises during the time period of the study. Scaffolded scoring allowed more opportunities for these students to achieve points and progress in the game. However, it was an interesting occurrence when a few students were offered five points for partial mastery, but turned them down, wishing to wait until the next piano lesson to attempt to earn all ten points at once.

Self-Efficacy Levels Persist

With regard to self-efficacy, it was thought that gamification might have a positive influence. As referred to in the literature review, the theory of self-efficacy posits that what is most important about student achievement is learners' beliefs about their ability to attain a specific goal. As Bandura explained, specific beliefs are extremely powerful predictors of what a learner is capable of achieving (Bandura, 1997).

It was anticipated that gamification might increase self-efficacy by providing participants with opportunities for success, and providing them with direct evidence of their ability to

achieve mastery of technical exercises in the form of audio recordings on their webpage. Weekly updates were sent to all of the participants in the experimental group detailing information about their progress, and including a link to their personal webpage where their recordings could be heard, and also "seen" as waveforms. All of the uploaded recordings of technical exercises played by the participants can be viewed and listened to here: https://soundcloud.com/heather-birch1. Contrary to the expectation that gamification would have an effect, and despite the fact that achievement levels were significantly different, self-efficacy levels in the control and experimental group were indistinguishable. A consideration of why gamification appeared to have no effect is discussed in the following section.

Self-efficacy levels of the participants did not change over the 9-week period of the study as anticipated, in either the control or experimental groups. Perhaps extended exposure to music learning, and a series of successful achievements over years of piano study, as opposed to nine weeks, would have revealed significant long-term changes. While gamification was not shown to affect self-efficacy levels in the context of this study, then, it could have a role in boosting the self-efficacy of piano students over a longer time period. Another potential explanation for the stability of self-efficacy scores across group is that piano students have high self-efficacy scores to begin with, leaving minimal room for improvement. Ritchie and Williamon (2011) have demonstrated that self-efficacy levels remain constant over time for those enrolled in music education programs, and that these levels are significantly higher than for children and adults who do not study a musical instrument.

Attitudinal Effects

Attitude was marginally affected by gamification. As in the case of self-efficacy, perhaps the limited length of the study was a factor which inhibited gamification from effecting a significant influence. Nonetheless, a difference in attitude toward practicing technique can cautiously be accounted for by gamification. If gaming elements can indeed positively affect even some piano students' attitude toward technical exercises, this is a powerful finding. The positive attitude a student has toward technique has the potential to stay with them long after the game is over, throughout months or even years of piano study. While achievement levels may only be affected while the gamification environment is present, positive attitudes may be a lasting legacy. Further research is needed to test this hypothesis.

Study Limitations

Confounding Variables

While gender, age, experience playing the piano, and studio were all examined to ensure they were not potential covariates affecting the study results, another confounding variable was discovered after the study began. While some students were beginning a brand new grade level and would be experiencing technical exercises they had never seen before, other students who had been working on that grade level in the past would have had opportunities to hear and attempt those technical exercises before. Once the study was underway, it was discovered that this factor could cause those in the latter group to master exercises faster than those in the former, yet it was too late to consider this as a

confounding variable.

Game Design Issues

One student expressed frustration when the points on her webpage were not updated immediately after she achieved them. Unfortunately, a limitation of the game, *Technique Tower,* was that seeing your points updated in real time on your webpage was not feasible. Students did see their teachers record points in their notebooks, and this often prompted fist pumps and exclamations of "Yes!" or "Yay!" But if players went to visit their site immediately following their piano lesson, their points were not be updated until a couple of days later, when their piano teacher reported their point totals for the week.

One game player commented on her webpage: "I don't understand why I have more points than other students, yet I'm at a lower level. I have to work harder on each technical requirement, they have to be faster and each one is much longer." While this is the way the game was originally designed, students in higher grade levels did not appreciate this inequity. However, their perception of the game as unfair did not demotivate them from playing the game and continuing to try to earn points by mastering technical exercises.

One of the factors to be evaluated in this study was the social context in which the players' points, achievement level, and performances were posted. This information was accessible to them, and email updates on their progress were sent to them and their parents each week. It was the intent of the study to collect all of the comments that people made on the players' webpages, and to evaluate their content in order to assess their

potential effect on student progress in the game. However, not many comments were posted on the student webpages. Therefore, these could not really be evaluated to any significant extent.

Another challenge within the study environment involved some parents who chose not to pass along information to their children about the game. If a parental email address was the only one provided on the record sheet, then this was how game updates were distributed. Sometimes at their lessons, participants would express confusion or surprise, not knowing about events that had occurred in the game. Their parents had either chosen not to, or had forgotten, to share game updates with them. There is also a chance that some parents did not receive the game updates, potentially because the messages ended up in their email account spam folder, and went undetected. One parent described to her child's teacher how he was not motivated by extrinsic rewards. Perhaps this parent assumed that the gamification environment established for the study only provided extrinsic rewards, and this resulted in her devaluing the game updates, thereby seeing no reason to share them with her child.

Competition was an unexpected dynamic which emerged during the study. There was no formal leaderboard in the game where players were ranked according to performance. However, players who clicked on other players' webpages to view their points and trophies could easily determine who was moving up the tower faster or slower than they were. One student commented that others were beating him, and another student expressed a desire to “win” the game by getting to the top of the tower first, although that

was never presented to students as a scenario, and no reward was offered for such an achievement. Woodruff (2012) refers to competition, saying, “We naturally compare ourselves to others. Even if we say we don't like competition, we often mean, we don't like losing, and we are competitors.” Out of the 10 students playing the game, 6 expressed competitive tendencies, i.e. referring to the progress of other students in comparison to their own, and making statements about their desire to get more points or more bonus stars than other students.

Finally, the small number of students in this study is a limiting factor. Additional studies are needed to better understand the wider impact of gamification in piano practice research.

Ideas for Future Research

Future research in the area of gamification could measure students' motivation to practice technique, as well as their self-efficacy levels and attitudes over a full year of piano study, to determine long-term effects. Similar studies with larger sample sizes could provide further evidence of gamification's role in motivating students. Integrating additional gaming elements such as chance and curiosity into *Technique Tower*, or further developing some of the existing elements, such as story and social interaction, could provide an even more effective gamification environment within which to test student motivation. Further study is needed on how the virtual nature of rewards in this study are able to motivate students, and on whether increased intrinsic motivation to practice technique remains once the gaming environment has been removed.

Conclusion and Educational Application

The findings from this study are applicable to private piano teachers who seek to motivate their students to practice technical exercises more often and more regularly. They may benefit from the use of gamification to increase student motivation to practice technique. Parents of private piano students may also be interested in how elements of gamification can influence their child's piano practice time and experience. Ultimately, students can benefit from a gamified environment if their playing improves based on their increased practice of technical exercises. While this study represents data collected from private piano studios, it is likely that the results could be used as a model for studios which provide lessons for other instruments such as guitar, violin, or flute. It may also provide a model for other scenarios in which student learners must spend time outside of class to consistently practice skills to gain mastery, such as home reading programs designed to develop reading fluency, and numeracy programs designed to increase accuracy and speed of math facts recall.

Overall, this study has shown that gamification can be successfully implemented in an educational context. Further study is necessary to determine which gaming elements can maximize the impact on student motivation and achievement, and on whether both extrinsic and intrinsic motivation can both be influenced by gamification.

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Appendix A

Scripts for Lesson 1

Lesson 1 Script to read to Group 1 Participants (Control Group)

Hi _____ (student name). For the next two months you and I will be part of a research study which is set up to try to discover some ways to motivate students to practice. At each lesson I will give you a list of exercises to practice. On each lesson day, you (or your parents) will receive an email link to a video which shows someone playing those exact exercises. You can watch the video and listen for ideas about how to play those exercises. When you come back for a lesson the next week, I will ask you to play those exercises for me, and we will write down which level you are at with each exercise - “Still Working On It”, “Getting There” or “Got it”. Does this sound OK with you? (Wait for response). OK, for next week I would like you to practice technique in the Key of _____. Do you have any questions?

Lesson 1 Script to read to Group 2 Participants (Experimental Group)

Hi _____ (student name). For the next two months you and I will be part of a research study which is set up to try to discover some ways to motivate students to practice. We are going to be playing a game called "*Technique Tower*." Here is a list of all the technique for Grade _____ (student's grade level). (Give student the paper copy of the list). When you practice each of these exercises on this list, you will have the chance to earn points. If you earn ____ points you will go up to the next level in the tower. When you earn ____ points, you will reach the very top of the tower. That is how you win this game. You will get to choose an alias. (Let the student choose an alternate name for themselves and write it down on the Mastery Record Sheet. This can be a real name such as "John" or a username such as "Robot22", but should not have their real name as part of it). All the players in this game have their own web page. Your web page will have an avatar that you will create, and also the number of points you have earned. You (or your parents) will receive an email link to a video which shows someone playing all of the technical exercises you have to practice to reach the top of the tower. You can watch the videos and listen for ideas about how to play those exercises. When you come back for a lesson the next week, I will ask you to play any exercises you want for me, and we will write down which level you are at with each exercise. Recruit Level means you have really just started working on it. That earns you 0 points. Veteran Level means you are experienced playing that exercise, and that earns you 5 points. Master Level means you have played it with precise musical skill, and that earns you 10 points. Does this sound OK with you? (Wait for response). OK, here is a list of all the technique you have to learn to make it to the top of "*Technique Tower*." Do you have any questions?

Appendix B

Performance Measure Rubric

Group 1 Category Labels:	Learning	Almost There	Got It
	Recruit	Veteran	Master
Posture & Hand Position	slumps back, tension in fingers, hands, or forearms, flattens fingers	tension or incorrect hand position may arise at times during the exercise; elbow, wrist and hand may not consistently rotate freely as needed	sitting up straight, forearms straight, curved fingers, moves fingers up higher on the keys when needed to facilitate natural hand shape, hands and forearms are relaxed; elbow, wrist and hand rotate freely as needed
Notes	some incorrect notes	correct notes are known but not always reached on the first try	notes are correct
Fingering	problematic fingering causes errors, unnatural hand position, accuracy or rhythmic compromises	recommended fingering is known but not always used on the first try; challenging finger stretches or tucks cause slight hesitation	recommended fingering is used; challenging finger stretches or tucks are done seamlessly
Tempo	minimum tempo is not yet reached	tempo is close to the required speed	minimum tempo (or faster) is played evenly
Rhythm	rhythmic inconsistency, or rhythmic pulse is not evident	rhythm is mostly even with slight inconsistencies, or rhythmic pulse is not consistent	rhythm is even, with a good musical pulse
Tone	tone is uneven or fuzzy (notes overlap)	tone is mostly even, or tone is rigid	tone is balanced, clear and even; the exercise is shaped with a slight crescendo on the way up and diminuendo on the way down
Articulation	legato or staccato touch is not evident	legato or staccato touch is not consistent	legato or staccato touch is effective

Appendix C

Example of a Chart Detailing the Required Technical Requirements for RCM Grade 4

Scales*	Keys	Played	Tempo	Note Values
Parallel Motion Scales	D, A, B♭, E♭ major B, F#, G, C minor (harmonic and melodic)	HT 2 octaves	♩ =92	♫
Staccato Scales	D, B♭ major B, G minor (harmonic)	HS 2 octaves	♩ =104	♫
Formula Pattern Scale	C minor (harmonic)	HT 2 octaves	♩ =92	♫
Chromatic Scale	Beginning on D	HS 1 octave	♩ =104	♫

*All scales are to be played *legato* unless otherwise indicated.

Chords	Keys	Played	Tempo	Note Values
Triads (root position and inversions) broken	D, A, B♭, E♭ major B, F#, G, C minor	HS 2 octaves (no cadence)	♩ =76	
		HT 1 octave (ending with V-I cadence)	♩ =60	
solid (blocked)	D, A, B♭, E♭ major B, F#, G, C minor	HS 2 octaves (no cadence)	♩ =132	♩ 𝄽
		HT 1 octave (ending with V-I cadence)	♩ =120	♩ 𝄽

Arpeggios	Keys	Played	Tempo	Note Values
Tonic (root position)	D, A major G, C minor	HS 2 octaves	♩ =72	♫

Royal Conservatory of Music. (1989, 2005, 2008). Technical Requirements for Piano Book 4. 2008. Mississauga, ON: The Frederick Harris Music Co., Ltd. All Rights Reserved. Used by Permission.

Appendix D

Ethics Approval Letter

UNIVERSITY OF TORONTO

OFFICE OF THE VICE PRESIDENT, RESEARCH

PROTOCOL REFERENCE # 28065

August 27, 2012

Dr. Earl Woodruff
DEPT OF HUMAN DEVEL. & APPL. PSYCHOLOGY
OISE/UT

Ms. Heather Birch
DEPT OF HUMAN DEVEL. & APPL. PSYCHOLOGY
OISE/UT

Dear Dr. Woodruff and Ms. Heather Birch,

Re: Your research protocol entitled, "The motivational effects of the gamification of piano instruction and practice"

ETHICS APPROVAL	**Original Approval Date: August 27, 2012** **Expiry Date: August 26, 2013** **Continuing Review Level: 1**

We are writing to advise you that the Social Sciences and Humanities Research Ethics Board (REB) has granted approval to the above-named research protocol under the REB's delegated review process. Your protocol has been approved for a period of **one year** and ongoing research under this protocol must be renewed prior to the expiry date.

Any changes to the approved protocol or consent materials must be reviewed and approved through the amendment process prior to its implementation. Any adverse or unanticipated events in the research should be reported to the Office of Research Ethics as soon as possible.

Please ensure that you submit an Annual Renewal Form or a Study Completion Report 15 to 30 days prior to the expiry date of your current ethics approval. Note that annual renewals for studies cannot be accepted more than 30 days prior to the date of expiry.

If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

Yours sincerely,

Margaret Schneider, Ph.D., C.Psych
REB Co-Chair

Sarah Wakefield, Ph.D.
REB Co-Chair

Dean Sharpe
REB Manager

Appendix E

Mastery Record Sheets

Record Sheet for Group 1 Participants

Participant Number:	Gender: M / F
Birthday: (Month/Year)	Email:
RCM Grade Level: Prep 1 2 3 4 5 6 7 8 9	

	Key/exercises Assigned
Week 1 Date:	

	Key Assigned	Technical exercises played for the teacher		
Week 2 Date:		Still Working On It	Almost There	Got It

	Key Assigned	Technical Elements played for the teacher		
Week 3 Date:		Still Working On It	Almost There	Got It

	Key Assigned	Technical Elements played for the teacher		
Week 4 Date:		Still Working On It	Almost There	Got It

	Key Assigned	Technical Elements played for the teacher		
Week 5		Still Working On It	Almost There	Got It
Date:				

	Key Assigned	Technical Elements played for the teacher		
Week 6		Still Working On It	Almost There	Got It
Date:				

	Key Assigned	Technical Elements played for the teacher		
Week 7		Still Working On It	Almost There	Got It
Date:				

	Key Assigned	Technical Elements played for the teacher		
Week 8		Still Working On It	Almost There	Got It
Date:				

	Key Assigned	Technical Elements played for the teacher		
Week 9		Still Working On It	Almost There	Got It
Date:				

Record Sheet for Group 2 Participants

Participant Number:	Gender: M / F
Birthday: (Month/Year)	Email:
RCM Grade Level: Prep 1 2 3 4 5 6 7 8 9	Alias:

Week 1 Date:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 2 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 3 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 4 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 5 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 6 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 7 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 8 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

	Technical Elements played for the teacher			Total Pts	Bonus Star Awarded
Week 9 Date:	Recruit (0 pts)	Veteran (5 pts)	Master (10pts)		Yes / No Reason:

Appendix F

Self-Efficacy Measure

Participant ID: _____

- Show students the overview of the technical requirements for their grade level.
- Ask students in both groups to rate these statements twice: At Week 2, and again at Week 9.
- Do not let students see their previous answers.

	Not at all sure						Completely sure
Week 2: (use red pen to circle numbers) Date _____ Week 9: (use blue pen to circle numbers) Date _____	0%						100 %
1. I am sure that I can learn to play the technical requirements for this grade level.	1	2	3	4	5	6	7
2. I am sure I can practice when I should to learn the technical requirements for this grade level.	1	2	3	4	5	6	7
3. If I cannot play the technical requirements for this grade level at first, I will keep practicing until I can.	1	2	3	4	5	6	7
4. I can learn all the things I want to help me play the technical exercises for this grade level.	1	2	3	4	5	6	7
5. I am likely to give up practicing these technical requirements before I get really good at playing them.	1	2	3	4	5	6	7
6. If I find these technical requirements boring or tricky, I can stick to it until I learn them.	1	2	3	4	5	6	7
7. When I decide to learn these technical requirements I start to practice them right away.	1	2	3	4	5	6	7
8. When first practicing technical requirements, I soon give up if I can't play them right away.	1	2	3	4	5	6	7
9. The idea that I might make mistakes when playing technical requirements for my teacher makes me work harder to learn how to play them well.	1	2	3	4	5	6	7
10. I am likely to give up on working toward learning these technical requirements.	1	2	3	4	5	6	7
11. If I get stuck when learning these technical requirements, I can work it out.	1	2	3	4	5	6	7

Appendix G

Attitudinal Measure

1. I love practicing scales and triads.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
2. I practice scales and triads because they help me become a better player.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
3. I always practice my pieces first, and then scales and triads if I have time.	Always!	Most of the Time	Don't Know	Sometimes	Never
4. I do NOT enjoy practicing scales and triads.	Always!	Most of the Time	Don't Know	Sometimes	Never
5. Practicing scales and triads is fun.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
6. I feel good after I have practiced scales and triads.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
7. Practicing scales and triads is boring.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
8. I practice scales and triads more now than I used to.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
9. I feel happy when I practice scales and triads.	Totally Yes!	Yes	Don't Know	Not Really	No Way!
10. Scales and triads are awesome.	Totally Yes!	Yes	Don't Know	Not Really	No Way!

Appendix H

Online Interview Protocol

1. When you earn points in the game, Technique Tower, how do you feel?

□ happy	□ powerful	□ safe	
□ selfish	□ strong	□ confident	
□ greedy	□ sad	□ confused	
□ excited	□ angry	□ competitive	□ other: _____

2. When you earn a trophy in the game, how do you feel?

□ happy	□ powerful	□ safe	
□ selfish	□ strong	□ confident	
□ greedy	□ sad	□ confused	
□ excited	□ angry	□ competitive	□ other: _____

3. Have you earned a bonus star in this game? Yes / No (If no, go to Question 5).

4. When you earned a bonus star, how did you feel?

□ happy	□ powerful	□ safe	
□ selfish	□ strong	□ confident	
□ greedy	□ sad	□ confused	
□ excited	□ angry	□ competitive	□ other: _____

5. Do you have any comments about the game that you would like to tell us?
6. Give *Technique Tower* a fun score out of 10. Choose one number.

Most Boring Game Ever Totally Fun Game

1	2	3	4	5	6	7	8	9	10

7. Give *Technique Tower* a fairness score out of 10. Choose one number.

Totally Unfair Game Very Fair Game

1	2	3	4	5	6	7	8	9	10

8. Do you think the *Technique Tower* game is a good way to get piano students to practice technique? Give it a score out of 10.

1	2	3	4	5	6	7	8	9	10

9. Finish this sentence. When I get to the top of technique tower...

10. Did messages from Technique Turkey remind you to practice technique?

No Not Really Sort Of Sometimes Yes

Appendix I

Teacher Interview Protocol – Parts 1 & 2

Part 1 – Week 1

Introduction. Thank-you so much for agreeing to be part of this study. This is an opportunity for me to get to know some of your thoughts and feelings about technical exercises, and about how you motivate your students to practice. I will make an audio recording of this interview, and then type out your responses. I will email you a copy so that if there is anything you would like to change or add, you can let me know at that time and I will make the appropriate changes. Does all of this sound alright to you? (Wait for response). Great. Let's begin with question 1.
1. What are some of your usual methods for motivating students to practice?
2. What are your feelings about students practicing technical exercises such as scales, chords and arpeggios?
3. How do you usually assign technical exercises for students to practice?
4. If you ever have a student get upset in a lesson for any reason, how do you handle this?
5. Do you yourself regularly practice technical exercises such as scales, chords and arpeggios? Why or why not?

6. How do you reward student success?
7. Describe your students' typical attitude toward practicing technical exercises.

Part 2 – Week 9

8. Did you have any interesting, frustrating, surprising or exciting moments throughout the period of the study that you would like to share about?
9. Did any of your feelings about practicing technical exercises change throughout the period of the study?
10. What changes could you suggest to the game "Technique Tower" to make it a more effective means for motivating students to practice technique?
11. Do you think the game "Technique Tower" could have applications in a broader context within piano instruction, i.e., to keep track of pieces learned and ear training skills?
Conclusion. Thank-you so much for your answers. I really appreciate the contribution you have made to this study. When I have finished analyzing the results, I would like you to read over the findings and discussion, and give your feedback. Have a great day.