CHAPTER 4

Gamification and Formal Practice: A Pilot Study on Gamification's Contributions to Early Childhood Student Teachers' Musical Practice

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Abstract: Practice is, and will always be, one of the fundamental ways of attaining musical skills. However, the efficiency of skill acquisition will be dependent on the quality and quantity of musical practice. On the one hand, a learner can be dedicated in their practice, seeking guidance to improve their own weaknesses and strategize their practice time, reminding us of *formal practice*. On the other hand, a learner can lack dedication or even be amotivated by practicing without effort or goals, reminding us of *informal practice*. This pilot study explores how *gamification* can potentially contribute to formal practice and song acquisition, incorporating game elements like reward systems, level gaining, competition, cooperation, storytelling, and goals into a ukulele and song course. This intervention design tested early childhood student teachers (n = 60) at Queen Maud University College (DMMH) of Early Childhood Education.

Keywords: gamification, game elements, deliberate practice, formal practice, ukulele, singing, motivation, pilot study, exploratory study, intervention design

Whether training to become an athlete or practicing as a musician, one can systematically repeat dedicated exercises to achieve improvement (Martin, 2008). When Muhammed Ali was hitting a punching bag for one hour each day, he was perfecting specific punching techniques by

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using immense amounts of repetition, focus, and dedication. Similarly, repetitive and concentrated practice on the specific chord progression D, A, B minor and G, would prepare the ukulele player for the song "I'm yours" by Jason Mraz. In both these examples, *deliberate practice* is recognized, in which a student practices in a goal-oriented, determined, and concentrated manner (Barry & Hallam, 2003; Bonneville-Roussy & Bouffard, 2015). Ericsson and Lehmann (1999) describe deliberate practice as "structured activity, often designed by teachers or coaches with the explicit goal of increasing an individual's current level of performance" (p. 695). However, Bonneville-Roussy and Bouffard (2015) stress that deliberate practice alone insufficiently explains optimal practice, and suggest the term *formal practice* as an integrative framework incorporating two additional components, namely *self-regulation* strategies and *practice time*. Self-regulation is further characterized by the student's ability to reflect on his or her strengths, weaknesses, learning capability (metacognition), and practice environment (McPherson & Zimmerman, 2002). Practice time is the third component, described as the total amount of an individual's contributed practice (Bonneville-Roussy & Bouffard, 2015).

Several studies by motivational theorists indicate that a subject's perception of musical competence strongly influences their potential to practice (Bonneville-Roussy & Bouffard, 2015; Hallam, 1998; McPherson & McCormick, 1999). The self-efficacy principles include experiences of successes and failures, social comparisons, the nature and quality of the feedback received, and psychological and emotional reactions to the task (Bandura, 1986, 1993). Utilization of self-confidence, resources, motivation, and effort predict musical achievement (Hallam, 2013). On the one hand, lower achievers may be deluded by never being able to learn an instrument because of their innate skills, reflecting poorly on their musical self-efficacy, consequently resulting in limited practice. On the other hand, higher achievers believe that they are musically gifted and competent, and they spend more time on practice and better strategize their practice (Bonneville-Roussy & Bouffard, 2015). Furthermore, based to a large extent on the research by Ericsson et al. (1993), it is suggested that practitioners with higher levels of expertise better

understand the fruits of optimal practice, thereby incorporating deliberate practice.

Educational science often tries to explore the effect of different learning strategies and techniques, typically to appeal to and motivate students. A recent, and maybe more untraditional endeavor, is the gamification approach, where elements from video games are appropriately incorporated to solve problems, encourage learning and stimulate a positive learning environment (Kapp, 2012). However, research on gamification focuses on motivation and achievement, and less on the actual quality and quantity of practice. During two weeks, O'Neill (1997) discovered more quantity of practice present with higher-achieving beginning instrumental music students than lower-achieving students. She also observed a relationship between their motivational profile and the effectiveness of practice. To better comprehend and predict musical achievement one must study both the quantity and quality of practice (Barry & Hallam, 2003).

This study recognizes gamification and formal practice as two key concepts. Based on these concepts theoretical and empirical findings produced the main research question: How can gamification (independent variable) contribute to early childhood student teachers' formal practice (dependent variable)? Furthermore, the research design tests analytical methods, gamified elements, questionnaires, learning material, and other means of gathering data in a viable and ethical manner. Assessment of these findings should prove valuable for the main trial, where a more comprehensive design may explore significant effects of gamification on formal practice, keeping the advantages of the pilot study and simultaneously avoiding the pitfalls.

Theory

Gamification

Research literature stresses that digital tools can support music didactical teaching (Paule-Ruiz et al., 2017). An ocean of music applications, software, and other digital learning tools focus on making the learning

experience more accessible, motivating, attractive, and efficient. There is a consistent flow of new and sometimes revolutionary technology to enhance education. However, one must critically evaluate these applications before incorporating them into a learning environment, because not all of them are necessarily optimal for music learning. In a study of eight test participants with a wide variety of musical backgrounds, Graham and Schofield (2018) assess how students perceive Rocksmith as a learning tool to improve on the guitar, concluding that users tend to use the music application more as a video game than a learning tool. Some music applications can be immensely entertaining, but not necessarily as musically beneficent (Paule-Ruiz et al., 2017). These applications are seldom on their own automatically beneficent on the student's musical skill development; it depends on how the student or educator utilizes it. For example, music applications like Yousician, Rocksmith, and Rock Band measure if the player performs the right note, at the correct rhythm and pitch (approximately, but not always very accurately), and are rewarded accordingly by unlocking rewards and more content (Miller, 2013). The technology often does not evaluate the quality (timbre and fullness) of the tone, but merely confirms the tone produced. Rocksmith contains some in-game reminders on correct guitar technique, but forums frequently request more in-person video instructions (O'Meara, 2016). According to deliberate practice, a student must get sufficient feedback on ways to improve; something a teacher would typically do (Ericsson & Harwell, 2019). By incorporating the guidance of a teacher, the students could learn through Rocksmith more beneficently. A teacher with sufficient insight and skills on the guitar (or similar string instruments, like the ukulele) could provide feedback on strumming and fingering techniques, guiding the student towards creating satisfactory sounds with correct usage of their right and left hands. The educator must obtain sufficient competence and reflection regarding the usage of ICT, music, and didactics, thereby creating productive learning environments and avoiding potential pitfalls (Paule-Ruiz et al., 2017).

In educational music video games, players engage in musical content through some sort of gamified software. There has been extensive research on the implementation of educational games in various learning

environments (Barton & Stacks, 2019; Birch & Woodruff, 2017; Graham & Schofield, 2018; Nebel et al., 2016). Both Yousician and Rocksmith are video games based on playing an actual instrument to progress in levels and challenges. In the study of Graham and Schofield (2018), two test experiments observed how participants would utilize Rocksmith as a learning tool for guitar. Despite the participants perceiving Rocksmith more as a video game than a learning tool, the in-game progression and leveling system seemed to motivate them to play the guitar through the game. Participants of both studies experienced playing Rocksmith as a fun, entertaining, and beneficial way of learning some aspects of the guitar, however, with some frustrations regarding technical issues. Rocksmith is a videogame, which often is "a system in which players engage in an abstract challenge, defined by rules, interactivity, and feedback, that results in a quantifiable outcome often eliciting an emotional reaction" (Kapp, 2012, p. 7). These quantifiable outcomes are experience points, unlocks, badges, achievements, and other measurements of the player's progression (Dicheva et al., 2015).

Rocksmith and other similar musical video games use in-game contributions to motivate players to learn an instrument through the video game itself (Graham & Schofield, 2018). Using gamification does not necessarily imply using an actual video game. "Gamification is using game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (Kapp, 2012, p. 125). Gamification is all about extracting the game mechanics, or game elements, of a video game into a learning environment, whether it is an actual video game or not. These game elements are the driving forces behind a video game, which makes them motivational, exciting, and sometimes even addictive. Gamification occurs when we make use of these elements in a non-game context to motivate and increase interest around an activity, like learning an instrument, exercising, and drilling mathematical equations (Deterding et al., 2011; Gee, 2008). The vast amounts of existing games contain numerous gaming elements, exploited differently from game to game. Examples of game elements are abstractions of concepts and reality, goals, rules, conflict, competition, cooperation, time, reward structures, immediate feedback, levels, storytelling, aesthetics, and replayability (Gee, 2007).

One research study specifically surveys the motivational effects of gamification on two groups of young piano students, consisting of a control and a experimental group of ten people each over nine weeks. Here, Birch and Woodruff (2017) assessed how gamification could affect their practice on technical disciplines, like arpeggios, scales, chords, and fingering. Through completing different piano exercise challenges, recorded on an online website called "Technique Tower," the students obtained badges, points, and level achievements. Furthermore, they found that the experimental group had significantly higher achievement scores than the control group. Similarly, with Graham and Schofield (2018), the students in this study also experienced some frustration with the technical aspects. Birch and Woodruff (2017) also recognized an increase in manual labor for the teachers, especially when monitoring students' practice recordings, and suggested more automated solutions for future studies. In a single case study with three groups totaling 75 students aged 10–13 years, consisting of a control group ($n = 25$), experimental group A ($n = 26$) and experimental group B ($n = 24$), Gomes et al. (2014) introduced a gamified journey with step-by-step challenges to unlock new content. Here they discovered that both the experimental groups became more internally motivated in music skill acquisition.

Gamification and Motivation

According to Ryan and Deci (2000), "motivation concerns energy, direction, persistence, and equifinality – all aspects of activation and intention" (p. 69). Recent research on gamification and musical achievement tends to focus on how motivated an individual is for musical practice (Birch & Woodruff, 2017; Gomes et al., 2014; Graham & Schofield, 2018). This might not be surprising as *motivation* is a core concept of video games and, simultaneously, a crucial predictor of musical practice. Why else would anyone do anything in a video game, or by gamification, if it was not motivating? For a video game to be successfully engaging, its design must induce the player to progress and chase achievements, typically through positive encouragement like quantifiable rewards, such as badges, money, items, experience, and levels (Kapp, 2012).

The reward systems of video games are often negative and positive stimuli that affect the player to make decisions, reminding us of Skinner (1965). *Extrinsic motivation* compels learners to act to attain separable outcomes, often focused on obtaining future achievements that typically reward recognition from their teachers, peers, or parents (Sansone & Harackiewicz, 2000). Within self-determination theory, Deci (1985) stresses that when learning an instrument is forced upon by, for example, a study program, it might be alienating if not identifiable with any personal interests or goals. On the other hand, when learning to play an instrument is self-determined, externally motivated tasks would be more appealing, and *intergraded regulation* is present (Ryan & Deci, 2000).

Research by Bruner (1966) acknowledged that the sheer amount of positive or negative stimulus could not predict a decision to act or not, and stressed that motivation is a more complex phenomenon. By addressing the importance of *intrinsic motivation,* one acknowledges that learners act for the sake of their own innate psychological needs. The action rewards enjoyment, provides learning, and evokes feelings of accomplishment, which is identifiable with the learner's goals and interests (Deci & Ryan, 2000). When the gaming experience itself is rewarding enough, often because of its aesthetics, opportunities and provided autonomy, the player decides based on his or her inherent interests and psychological needs. This is recognizable as intrinsic motivation within a video game (Kapp, 2012). In this regard, Denis and Jouvelot (2005) stress that self-determination theory may highly qualify to identify motivational effects of gamification, especially on music learning, mainly because of its core components of innate psychological needs.

Deci and Ryan (2000) describe amotivation as "the state of lacking the intention to act" (p. 72). Amotivation may occur when the learner does not expect the action to generate a desirable outcome (Abramson et al., 1978), the learner does not value the action in accordance with their own interests and goals (Ryan, 1995), or when the learner does not feel competent to act successfully (Bandura, 1986). In a research design on how gamification may motivate musical practice, these amotivational principles may address some potential pitfalls. A recent study on the application Habitica, incidentally the same application used for the study presented

in this chapter, suggested that the gamified environment also had pitfalls that can lead to counterproductive effects, potentially leading to amotivation (Diefenbach & Müssig, 2019). These pitfalls regarded negative user experiences with the reward/punishment system and psychological reactions to counterproductive effects. Another study, based on 115 students playing an educational game-mode within Minecraft, deep-dived into the aspect of social competition, suggesting both positive and counterproductive effects (Nebel et al., 2016). Since both studies are limited in focus to only one game each, there cannot be any general assumptions on these counterproductive effects on games in general. However, these studies still point to potential pitfalls, warning educators to be careful and prepared when designing a gamified learning environment. A music learner is likely to practice as a result of different sources of motivation, both intrinsic and extrinsic (Lehmann et al., 2007).

Formal Practice

A general definition of practice is "repeated performance or systematic exercise for the purpose of learning or acquiring proficiency" (Cayne & Lechner, 1987, p. 787). An athlete would call it either training or practice since the two concepts are synonymous when doing sports. To the professional musician, practicing is to learn and improve proficiency through systematic exercises and experiences, and therefore is a crucial ingredient for musical skill acquisition (Austin & Berg, 2006). In the case of Schatt (2011), practice is referred to as "one of the most fundamental musical behaviors necessary to achieve success on a musical instrument" (p. 2). To understand the concept *formal practice,* one must deep-dive into the three components it consists of. These are *deliberate practice*, *self-regulation,* and *practice time.* Bonneville-Roussy and Bouffard (2015) stress that past research often addresses these components separately with musical achievement. Consequently, they constructed an *integrative framework of formal practice* as an analytical tool to address the three components as interactive elements. The framework was tested in a four-month prospective study on 173 music students between the ages of 17 and 30. They concluded that their framework would better predict musical achievement

than only assessing one of the components (Bonneville-Roussy & Bouffard, 2015).

Practice time is one of the vital components of Bonneville-Roussy and Bouffard's (2015) integrative framework, and describes the sheer quantity of minutes, hours, days, and years of contributed practice. Practice time is considered either formal or informal. Informal practice, which has been defined in various ways in literature, is typically playing songs that are already easily mastered, improvising, playing by ear, or just "messing about" (Barry & Hallam, 2003). Regarding informal practice, Platz et al. (2014) distinguish "between mere experience (as non-directed activity) and deliberate practice" (p. 1). Deliberate practice and self-regulation are often associated with high music achievers, while lower achievers tend to practice more informally (Ericsson et al., 1993; Krampe & Ericsson, 1996). Although according to the findings of Sloboda et al. (1996) high achievers are likely to report more informal practice than their less successful peers. By this they conclude that the highest achieving students have found the right balance between disciplined and free practice. Since deliberate practice often requires effort and hard work it is not inherently enjoyable (Lehmann & Davidson, 2002), especially since deliberate practice generates no immediate momentary rewards or accommodations (Ericsson et al., 1993; Krampe & Ericsson, 1996). In spite of researchers seeing informal practice as inferior to formal practice, informal practice is still practice. Beginners tend to practice more informally, while advanced musicians more often incorporate formal practice strategies (Barry & Hallam, 2003, Krampe & Ericsson, 1996).

There is an overall understanding that practice time predicts musical achievement, especially if one practices in a goal-oriented and focused manner, focusing on improving weaknesses (Barry & Hallam, 2003; Birch & Woodruff, 2017; Bonneville-Roussy & Bouffard, 2015). It is then recognized as *deliberate practice* (Ericsson et al., 1993), which a second vital component of formal practice mentioned. Neurological research sheds light on the neurological aspects of deliberate practice, describing how the neurons and synapses between them become more efficient and permanent if the human subject repeats a set of actions, described through processes like synaptogenesis, myelination, and pruning (Hallam, 2010).

Practicing the chord change from C to G could be an example of this process. At first, the ukulele player would spend time on mapping finger movement, especially when moving them simultaneously. After repeating this change after a set number of times, in a focused and dedicated manner, it would become easier and faster. For each successful chord change, neurological paths become more and more wired to execute this specific action.

In a study of three groups of violin students, recruited from the Music Academy of Berlin, Ericsson et al. (1993) suggest that a key to musical skill acquisition is the amount of time spent on deliberate practice. The three groups consisted of the 'best' group, the 'good' group, and the 'least accomplished' group. By studying recordings of the violinists' practice time, Ericsson et al. (1993) concluded that the differences in their level of expertise directly correlated with differences in the amount of deliberate practice time. In a later study on older expert and accomplished amateur pianists, Krampe and Ericsson (1996) argue that deliberate practice is essential for their original acquisition of musical competence, but also for maintaining their musical skills towards middle-age and adulthood. Here the amount of deliberate practice is most fruitful when the piano students participate in formal piano education, showing the importance of a mentor's influence on a music student (Ericsson & Harwell, 2019). Subsequent research adopting a similar approach by Sloboda et al. (1996) involved interviewing 257 young people aged between 8 and 18. They were practicing different types of instruments at different levels of expertise within the classical domain, and similar findings to Ericsson et al. (1993) and Krampe and Ericsson (1996) were found: High achieving musicians practiced more deliberately, sustained more day-to-day practice routines and, interestingly, tended to practice more in the morning than moderate and lower achievers. Also, some young musicians managed to obtain high-level grades with much less practice time than others with similar levels of expertise. One could then hypothesize that these musicians maybe had an adequate understanding of deliberate practice and strategizing their practice time (self-regulation). Through a similar study of 109 violin and viola students aged 6–16 at various levels of expertise, Hallam (1998) found that levels of expertise would be best predicted by the quantity of

practice and length of time playing an instrument. These findings predict musical achievement when sufficient practice time is present, especially if deliberate practice is recognized. However, while time spent on repeating dedicated exercises on the instrument is necessary for achievement, research stresses that deliberate practice alone does not explain musical achievement (Hallam, 2013; Meinz & Hambrick, 2010).

The third vital component of formal practice is the ability to organize and reflect on the practice itself. *Self-regulation* is apparent when music students are "metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1989, p. 329). When individuals learn music through belief in their own autonomy and the ability to obtain specific learning goals, self-regulation is recognized (McPherson & McCormick, 1999). More specifically, self-regulation strategies can be divided into six dimensions, describing a perspective on key processes involved in deliberate practice (Zimmerman, 1994, 1998); these were further reinterpreted by McPherson and Renwick (2001).

In a study of 101 high school woodwind players aged 14–18 over three years, McPherson (1997) assesses the students' capacity to sight-read, improvise, and play by ear and memory. The most proficient instrumentalists possessed a wide variety of practice strategies, resulting from high levels of metacognitive reflection on their ability and improvement. More specifically, some of the clarinetists went through mental rituals before initiating the main activity by chanting a melody before playing it and, in this way, getting the right "feel" and tempo (McPherson, 1997). Hallam (2001) studied fifty-five string players aged 6–18 years and found that effective practice strategy development related to the instrumentalists' musical expertise. Novices' practice strategies were less effective because they more seldom spent time on systematically correcting errors. However, in a further investigation of the relationship between self-regulation and musical achievement, Bonneville-Roussy and Bouffard (2015) stress that too little research has been conducted to provide strong evidence that self-regulation directly predicts musical achievement. In their opinion, *formal practice,* as integration between self-regulation, practice time and deliberate practice, can generate a more comprehensive understanding of the relationship between practice and musical achievement.

In addition to the music student's formal practice time, Ericsson and Harwell (2019) stress that the role of a well-qualified teacher is essential, which is described by three criteria. Firstly, the teacher assesses the specifics of what a music student needs to improve. Secondly, the teacher communicates how the student can reach goals within musical skill acquisition. Thirdly, the teacher describes and presumably designs the practice exercises necessary for this improvement (Ericsson & Harwell, 2019). In a study on beginner music students aged between 7 and 9 years, McPherson and Renwick (2001) observed that these students were not able to recognize their mistakes, and simply played through their repertoire repeating the same mistakes without making any essential improvements. The teacher's (and parents') guidance and expertise are crucial for directing students towards their musical achievement (Davidson et al., 1998).

Aims and Objectives

This study hypothesizes that gamification can motivate practice and, more specifically, that:

1. Gamification contributes to increased practice time, both formal and informal.
2. Gamification contributes to increasing the student's repertoire through song acquisition.

These hypotheses are based on the author's and students' experiences, attitudes and motivations within the gamified environment and learning material. In addition, earlier studies also indicate that gamification contributes to musical practice (Barton & Stacks, 2019; Birch & Woodruff, 2017; Graham & Schofield, 2018; Nebel et al., 2016). However, there is a need for additional research to understand this effect better, which is the aim of the future trial that this pilot study will facilitate. Furthermore, this study aims to examine merits and pitfalls within the research design. The findings and experiences of the pilot study will facilitate a future and more extensive research design, evaluating the feasibility of gamification's

contributions to musical practice (Ross-McGill et al., 2000). With a larger sample size, appropriate analytical methods, a quasi-experimental pre-test/post-test scenario, and other modifications, the main trial will try to shed light on the hypotheses.

Methods

For this pilot study, early childhood student teachers at Queen Maud University College of Early Childhood Education (DMMH) participated in an experimental gamified environment, designed to learn playing the ukulele and songs. This pilot study prepares a future and more extensive trial, assessing the relevance of the theoretical framework and methodology on how gamification can motivate musical practice (Lancaster et al., 2004). In preparation for the main trial, several aspects of the research design were assessed, including the application Habitica, game elements, questionnaire, analytical methods, and tools to gather participant data. I designed and taught the ukulele and song course for both the control and experimental groups, carefully watching that both groups got the same guidance and learning material, although the only difference was the use/absence of gamified learning elements. Formal practice, informal practice and song acquisition are the dependent variables in question, while the gamified elements are the independent variable that affects the experimental group. Acquiring a song repertoire is mandatory for early childhood student teachers at DMMH and provides a quantifiable measurement that may indicate practice. In addition, for the future trial, correlations between song acquisition and formal/informal practice may shed light on the effects of gamification on musical practice.

Participants, Procedure and Measurement

Two of my classes consisted of 85 students attending the standard bachelor program for early childhood education. However, the sample size was reduced to 60 participants ($N = 60$) due to sickness and students ending their program before testing. The age of most participants was between 20 and 24. SPSS calculated the interquartile range, identifying

three outliers within the experimental group (aged 31, 37, and 45) and two outliers within the control group (33 and 44). As Table 1 shows, gender distribution was similar for both classes, with a greater number of females than males (which is in line with the student population's gender distribution at DMMH).

Table 1. Descriptive Statistics of Participants.

Number of participants (N = 60)	Control group (n = 29)	Experimental group (n = 31)
Male/female	24/76 %	23/77 %
Mean age (SD)	22.8 (3.7)	23.0 (5.2)

The university divides all bachelor students into classes by complete randomization. Therefore, both the experimental and the control group are considered to be randomly assigned. There was one measurement time point after the intervention. Hence, the questionnaire prepares for a future main trial, which will ultimately conduct a proper pre-test/post-test scenario.

The university accepts applicants solely based on their average grade from their previous education, and not on any preliminary music audition, nor by any previously-taken music subjects, which often results in varying musical competence within the classes. The study prioritized protecting the students' privacy, confidentiality, and anonymity through an anonymous questionnaire. The students voluntarily signed a participation agreement prior to the study, ensuring that nothing could be traced back to anyone.

This pilot study is an experiment to improve music education in affiliation with the research group Music Technology in Education (MusTed), with no external or internal funding. I have been teaching guitar, ukulele, singing, composition, musical theory, and music pedagogy for almost seven years. I have taught and carried out research as an assistant professor at DMMH for almost four years.

This study uses a gamified task manager called Habitica as a gamified motivator for the experimental group. Simultaneously, the control group received the same teaching, guidance, lectures, assignments, and learning

material (like video tutorials, PowerPoint presentations, and repertoire). The course also demands 80% physical presence by the students. Other than this, the amount of practice, contribution, and involvement were entirely up to themselves.

This pilot study gathers its data through a quantitative and qualitative questionnaire on the students' practice time, attitudes toward gamification, music practice, and musical background. In Habitica, the players could complete 15, 30, and 45-minute practice challenges, eventually stored in the player's history-bank of "completed challenges," showing the total amount of practice time over a given period. The control group was encouraged and reminded to track their practice time through a written diary. The students had to specify if their practice time was informal or formal. Lectures in both classes thoroughly explained the difference. The questionnaire asked the participants the following types of questions regarding their:

- Practice time, both formal and informal, like "how much have you practiced formally? Please write the answer in minutes".
- Songs and chord acquisition, like "how many songs have you learned? You can select the songs suggested under and write songs learned outside of these."
- Attitudes and experiences in the gamified environment, like "which gamified elements were particularly motivating?"

Based on an evaluation of the difficulty of chords and songs, a point system was calculated. A difficult song, demanding changing melodies, chords, and text, could generate up to eight points. An easy song consisting of only a few chords, repeating melodies and texts, could generate down to one point. The sum of the songs equaled a total score of points, representing song acquisition. A similar point system represented chord acquisition, based on fingering difficulty.

Intervention Design: Habitica

Habitica is an online application based on the principles of a role-playing game (RPG) – a video game genre in which players must interact with

the surrounding world from the perspective of their controlled avatar. The avatar typically has several character-specific attributes, skills, and abilities. Players may achieve goals and complete challenges in an RPG, further rewarding them experience points, gold, gear, and other gadgets that help them progress further in the story (Barton & Stacks, 2019).

As the "ukulele sensei," I formed a guild consisting of all the students' avatars, and from here, we collectively faced adventure, challenges, defeated monsters, and completed quests through ukulele practice and singing. I specifically engineered these challenges to guide the students toward formal musical practice by learning repertoire, correct technique, deliberate practice, and self-regulation (Bonneville-Roussy & Bouffard, 2015). When a student had completed 45 minutes of formal practice, or learned a new song from their repertoire, the student could go into the application and register these accomplishments, unlocking rewards from these challenges. These achievements would also inflict damage on the monsters they were facing. One of the most rewarding endeavors was the song challenge. Each student could individually or in groups record themselves playing and singing a song, send it to the ukulele sensei, and get this song either approved or not approved. In addition, the players had the option to obtain extra rewards by completing bonus challenges within the same song, like playing them by heart or using more advanced strumming or fingering techniques. Based on the song's difficulty, the players were accordingly rewarded by gold and experience, further used for developing their avatar's abilities, itemization, consumables, and pets. A gold-star sticker mark, which participants could attach to their ukulele, was also purchasable as an in-real-life (IRL) reward at the cost of 100 gold pieces within Habitica. The control group was given the same challenges, guidance, encouragement, and feedback, but only as regular assignments without the gamified elements. If the players did not get their song approved due to either unsatisfactory singing or playing, I would provide the necessary feedback and guidance for them to complete the song successfully. In Habitica, players could reap the quantifiable rewards through three different systems within Habitica's task-managing interface, each consisting of a difficulty range between trivial, easy, medium, and hard. All these challenge systems were specifically designed

to promote practice and song acquisition. Formal practice yielded slightly more rewards than informal practice, indicating that focused, structured, and dedicated practice is preferable.

- *To-Dos* are one-time tasks, like "learn how to tune your ukulele" (hard) and "learn 'Row, Row, Row Your Boat" (medium). When the players completed all their To-Dos, the ukulele sensei initiated another to-do list for the particular player with more difficult one-time tasks, like harder songs and chords.
- *Dailies* are tasks only doable once per day. Habitica rewards the player extra daily-streak bonuses for each consecutive completed daily challenge. Examples of dailies are "practice deliberately for 45 minutes" (hard) and "tune your ukulele" (easy).
- *Habits* are infinitely repeatable challenges, like "practice deliberately for 15 minutes" (easy) and "learn a new song" (hard). Habits sometimes had corresponding tasks with daily challenges, giving the potential of double-completions. I specifically engineered these "conveniences" to appeal to deliberate practice and song acquisition. For instance, completing three habits of "15-minute deliberate practice" would also unlock the reward for the daily challenge of "45 minutes with deliberate practice", doubling the reward potential for 45 minutes of deliberate practice.

To spice up the story and sense of cooperation, the ukulele sensei would also announce upcoming battles and crises in the guild, allowing the players to gain double rewards for completing group challenges. Defeating some monsters required the players to group up, formally practice, rehearse and record songs, and get these approved by the ukulele sensei. In Habitica at Level 10, each player can choose a desired class (rogue, warrior, wizard, or healer), which benefits the party with different types of magic powers, making quests and monster hunting easier. I deliberately had a focus on these factors to enrich the narrative of the game, giving aspects of the game a deeper background story. Players were also able to view other guild members' progression, itemization, and pets, providing elements of competition.

Results

This pilot study explores a series of analytical methods, potentially relevant for seeing any cause and effect relationships between the dependent and independent variables (or, in other words: differences between the control and the experimental group). Hence, SPSS 26 was used to calculate independent sample *t*-tests:

1) The formal practice time, measured in minutes, reported by 28 subjects of the experimental group (M = 610.5, SD = 327.0) was higher than the report of the control group's 28 subjects (M = 566.8, SD = 240.7), but did not reach significance.
2) The informal practice time, measured in minutes, reported by the 28 subjects of the experimental group (M = 336.1 SD = 394.9) was higher than the reports of the control group's 28 subjects (M = 303.8, SD = 232.3), but did not reach significance.
3) Song acquisition, measured in song points, reported by 31 subjects of the experimental group (M = 21.94, SD = 19.75) compared to the 28 subjects of the control group, was significantly higher (M = 15.21, SD = 7.57; Welch's t-test, $t(39.13) = 1.763$, $p = .045$; $d = .45$).

My in-field role as an educator also allowed assessment of the participants' attitudes and responses to the gamified environment, musical practice, and educational material. Empirical data on both positive and negative user experiences are discussed in the following section.

Discussion

Intervention Design and Method

Evaluating the qualitative and quantitative data of the study gives indications for the main trial. As mentioned earlier, I specifically engineered the environment with gamified elements to encourage formal practice, mainly focusing on increasing song repertoire and formal practice. Some of the students experienced positive encouragement from the gamified elements, stressing things like "I am being tricked into practicing my

instrument to obtain rewards." Twenty out of 31 felt that in-game elements motivated them to practice, and 11 of these 20 felt that quantifiable rewards, like gold, were the most motivating element. Interestingly, participants stress that both in-game rewards and IRL (in-real-life) rewards (the gold star) were significant motivators, with a slight preference for the IRL reward. In this regard, students tended to do tasks that yielded most rewards, like learning songs and practicing formally. Based on experiences like these, the intervention design will further incorporate appealing game elements that encourage deliberate practice and song acquisition. The educator has the power to manipulate the gamified environment by deciding what yields rewards and prosperity, thereby manipulating the players' focus and goals.

Similar to other findings (Diefenbach & Müssig, 2019) on the counterproductive effects of gamification, similar pitfalls were recognized. Some unfair and unreasonably hard punishments, like, for example, death, resulted in some frustration by the participants. In future research design, the educator will prepare the participants to approach this game mechanic cautiously. Death is avoidable by buying health potions and recruiting healers for their party, among other things. Preparing the gamer for the dangers and pitfalls of a game could reduce unnecessary frustration in a game, optimizing gamification's effect (Diefenbach & Müssig, 2019; Gee, 2007). In this regard, I discovered an administrational setting that could undo losses, giving the players a second chance, which remedied some of the frustration. However, these administrational settings could also tweak other in-game stats, and possibly facilitate cheating, since they are accessible to all players. This is something that an educator using Habitica should be aware of.

Explaining Habitica in the mandatory classes, correcting bugs, and other misunderstandings were time-consuming and had consequences for the time spent on musical practice. Because of this, the control group had slightly more time on musical practice, since I had to spend some time introducing and explaining the gamified content to the experimental group. Interestingly, the experimental group still reported more practice time and song acquisition. Furthermore, participants needed time to understand and integrate all rules and functions of Habitica. Some

students never properly integrated this and decided to avoid using the application. Some students were discouraged due to the complicated content of Habitica and the comprehensive design of challenge systems. For the main trial, I will simplify and clarify the content, removing unnecessary content that might be more confusing than productive, possibly making the gamification more accessible. Based on the reports of this study, I suspect that the gamified content of this intervention design was too complicated.

This pilot study explores how quantitative data might look like in the main trial and tests appropriate analytical methods to illuminate these. Measuring any causality between variables requires a comprehensive design like true experimental studies with random controlled trials (RCT). Following this pilot study method will provide randomized groups, at least one experimental and one control group (expandable by four additional classes for each year), and the gamified environment as a research-manipulated variable. Incorporating a true experimental design will further include pre-test and post-test periods over a similar duration. No pre-existing differences or extraneous factors affected the participants, which will also apply to the future main trial (Gribbons & Herman, 1996). The main trial will incorporate formal practice, informal practice, and song acquisition as leading lines of evidence, possibly shedding light on hypotheses. However, more independent and dependent variables may be included in the main trial, like chord acquisition and musical background. Furthermore, qualitative methods may also help shed light on other musical practice perspectives, and are therefore being considered for the main trial. Triangulating qualitative methods, like focus groups, in-depth interviews, and participant observation with quantitative methods, like RCT, may prove valuable and enlightening.

Sample

A power analysis was conducted to find an appropriate sample size for the main trial (software G*Power, version 3.1.9.3), using a two-tailed test to analyze the means difference between group C and E. With a small effect size (d = 0,2) and alpha error = 0,2 results showed that a total of 128

participants with two equally-sized groups ($n = 64$) is sufficient to achieve the power level of 0.80. However, given that each class at DMMH never exceeds the limit of 45 students, two groups for the main trial will be impossible. Therefore, two control groups and two experimental groups will form the sample for the main trial, in theory consisting of at least 64 participants in each class.

The main trial will undergo a more comprehensive background check on the participants' musical profiles. Research indicates that high self-perception of musical competence correlates with higher amounts of practice quality and quantity (Barry & Hallam, 2003; Ericsson & Harwell, 2019). These circumstances might then affect the relationship between participants and the intervention design. The Goldsmiths Musical Sophistication Index (Gold-MSI) was created to thoroughly map individual musical profiles based on participants' self-reports on their musical skills and behaviors (Müllensiefen et al., 2014). Another instrument, called "music related competence belief" (KMI), also maps individuals' self-assessment of musical competence and experience (Harnischmacher et al., 2015). Both instruments would give a comprehensive mapping of each individual's musical profile and could serve as relevant covariates for group comparison. A corresponding background check on participants' relationships and experience with video games could potentially be valuable but is yet to be developed. The main trial will also make use of more extensive tools to examine the participants' motivational profiles, like the Motivation in Music Education Inventory (MMI) by Harnischmacher et al. (2015). Motivation often defines musical action by the individual's willingness and wish to perform. Another examinable factor is the participants' extent of "flow state". Hamari and Koivisto (2014) measure flow in the context of gamification through a comprehensive scale called Dispositional Flow Scale-2 (DFS-2). Even though Habitica typically is not an experience-heavy game, "flow state" can still be a valid factor in both playing the game and playing music.

Another limitation of the current study lies possibly in the faultiness of participants' self-reports on practice time. The gathering of quantitative data depends on participants' ability to record their practice time as accurately as possible. Those who utilized Habitica successfully recorded

their practice time automatically each time they checked off "x minutes practiced" tasks and was easily retrievable when collecting data. However, those who did not use Habitica, in the control group and some individuals in the experimental group, were given a diary to log their practice time, which they admittedly did not use as often as they actually practiced. Due to this, some students left empty answers in the questionnaire regarding practice minutes, resulting in some missing data. The data will be sounder if future research design incorporates a more precise tool to measure practice time and quality of practice correctly, especially for the control group. An application called Jibble could potentially provide this feature because of its ability to track participants when they "clock in" for musical practice. Another potential application is Clockify, where the user can start a timer when they practice, or manually type in their practice time. On the other hand, inserting another application research design may also overcomplicate things. Having a convenient and accurate way to track practice time (both informal and formal) is yet to be found. Fortunately, the questionnaire was more successful in tracking the actual songs learned by the participants. Using It's Learning (a digital learning management system) proved to be successful in monitoring and tracking completed songs by all participants.

Summary

This study applies to educators and researchers who seek to motivate musical practice through gamification. Based on observations, user experiences, and questionnaires, several pitfalls and merits surrounding the research design have been discovered, which further provide a valuable foundation for the main trial. Based on the experiences of this study, the main trial will attempt to examine if gamification can contribute any significant effects on musical practice.

References

Abramson, L. Y., Seligman, M. E., & Teasdale, J. D. (1978). Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology, 87*(1), 49.

Austin, J. R., & Berg, M. H. (2006). Exploring music practice among sixth-grade band and orchestra students. *Psychology of Music, 34*(4), 535–558.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational psychologist, 28*(2), 117–148.

Barry, N. H., & Hallam, S. (2003). Practice. In R. Parncutt & G. E. McPherson (Eds.), *The science and psychology of music performance: Creative strategies for teaching and learning* (pp. 151–165). Oxford University Press.

Barton, M., & Stacks, S. (2019). *Dungeons and desktops: The history of computer role-playing games. 2nd ed*. AK Peters/CRC Press.

Birch, H., & Woodruff, E. (2017). Technical exercise practice: Can piano students be motivated through gamification? *Journal of Music, Technology & Education, 10*(1), 31–50.

Bonneville-Roussy, A., & Bouffard, T. (2015). When quantity is not enough: Disentangling the roles of practice time, self-regulation and deliberate practice in musical achievement. *Psychology of Music, 43*(5), 686–704.

Bruner, J. S. (1966). *Toward a theory of instruction* (Vol. 59). Harvard University Press.

Cayne, B. S., & Lechner, D. E. (Eds.). (1987). *The new Lexicon Webster's dictionary of the English language*. Lexicon.

Davidson, J. W., Moore, D. G., Sloboda, J. A., & Howe, M. J. (1998). Characteristics of music teachers and the progress of young instrumentalists. *Journal of Research in Music Education, 46*(1), 141–160.

Deci, E. L. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268.

Denis, G., & Jouvelot, P. (2005, June 15–17). Motivation-driven educational game design: Applying best practices to music education. *Proceedings of the 2005 ACM SIGCHI international conference on advances in computer entertainment technology*, 462–465. https://doi.org/10.1145/1178477.1178581

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*, 9–15. https://doi.org/10.1177/1056492618790912

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: A systematic mapping study. *Journal of Educational Technology & Society, 18*(3).

Diefenbach, S., & Müssig, A. (2019). Counterproductive effects of gamification: An analysis on the example of the gamified task manager Habitica. *International Journal of Human-Computer Studies, 127*, 190–210.

Ericsson, K. A., & Harwell, K. W. (2019). Deliberate practice and proposed limits on the effects of practice on the acquisition of expert performance: Why the original definition matters and recommendations for future research. *Frontiers in Psychology, 10, 2396.* https://doi.org/10.3389/fpsyg.2019.02396

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363.

Ericsson, K. A., & Lehmann, A. C. (1999). Expertise. In M. A. Runco & S. R. Pritzker (Eds.), *Encyclopedia of creativity* (Vol. 1, pp. 695–707). Academic Press.

Gee, J. P. (2007). What video games have to teach us about learning and literacy. New York: Palgrave Macmillan.

Gee, J. P. (2008). Learning and games. *The ecology of games: Connecting youth, games, and learning, 3*, 21–40.

Gomes, C., Figueiredo, M., & Bidarra, J. (2014). *Gamification in teaching music: Case study* [Paper presentation]. EduRe'14, Valencia.

Graham, K., & Schofield, D. (2018). Rock god or game guru: Using Rocksmith to learn to play a guitar. *Journal of Music Technology & Education, 11*(1), 65–82. https://doi.org/10.1386/jmte.11.1.65_1

Gribbons, B., & Herman, J. (1996). True and quasi-experimental designs. *Practical assessment, research, and evaluation, 5*(1), 14.

Hallam, S. (1998). The predictors of achievement and dropout in instrumental tuition. *Psychology of Music, 26*(2), 116–132.

Hallam, S. (2001). The development of expertise in young musicians: Strategy use, knowledge acquisition and individual diversity. *Music Education Research, 3*(1), 7–23.

Hallam, S. (2010). The power of music: Its impact on the intellectual, social and personal development of children and young people. *International Journal of Music Education, 28*(3), 269–289. https://doi.org/10.1177/0255761410370658

Hallam, S. (2013). What predicts level of expertise attained, quality of performance, and future musical aspirations in young instrumental players? *Psychology of Music, 41*(3), 267–291.

Hamari, J., & Koivisto, J. (2014). Measuring flow in gamification: Dispositional flow scale-2. *Computers in Human Behavior, 40*, 133–143.

Harnischmacher, Höfer, U., & Blum, K. (2015). *Motivation in Music Education Inventory (MMI*). Universität der Künste Berlin. https://www.fem-berlin.de/app/download/6853131262/MMI_Kurzskala.pdf?t=1501059550

Harnischmacher, C., Carmichael, M., Höfer, U., & Blum, K. (2015). *Kompetenzerleben im Musik-unterricht Inventar, Kurzsskala (KEMI-S).* – Universität der Künste Berlin. https://www.fem-berlin.de/app/download/6853286162/KEMI_Kurzskala.pdf

Ibáñez, M.-B., Di-Serio, A., & Delgado-Kloos, C. (2014). Gamification for engaging computer science students in learning activities: A case study. *IEEE Transactions on Learning Technologies, 7*(3), 291–301.

Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. John Wiley & Sons.

Krampe, R. T., & Ericsson, K. A. (1996). Maintaining excellence: Deliberate practice and elite performance in young and older pianists. *Journal of Experimental Psychology: General, 125*(4), 331.

Lancaster, G. A., Dodd, S., & Williamson, P. R. (2004). Design and analysis of pilot studies: Recommendations for good practice. *Journal of Evaluation in Clinical Practice, 10*(2), 307–312.

Lehmann, A. C., & Davidson, J. (2002). Taking an acquired skills perspective on music performance. In *The new handbook of research on music teaching and learning* (pp. 542–560). Oxford University Press.

Lehmann, A. C., Sloboda, J. A., & Woody, R. H. (2007). *Psychology for musicians: Understanding and acquiring the skills*. Oxford University Press.

Martin, A. J. (2008). Motivation and engagement in music and sport: Testing a multidimensional framework in diverse performance settings. *Journal of Personality, 76*(1), 135–170.

McPherson, G. E. (1997). Cognitive strategies and skill acquisition in musical performance. *Bulletin of the Council for Research in Music Education, 133*, 64–71.

McPherson, G. E., & McCormick, J. (1999). Motivational and self-regulated learning components of musical practice. *Bulletin of the Council for Research in Music Education, 141*, 98–102.

McPherson, G. E., & Renwick, J. M. (2001). A longitudinal study of self-regulation in children's musical practice. *Music Education Research, 3*(2), 169–186.

McPherson, G. E., & Zimmerman, B. J. (2002). Self-regulation of musical learning. In R. Colwell (Ed.), *The new handbook of research on music teaching and learning* (327–347). Oxford University Press.

Meinz, E. J., & Hambrick, D. Z. (2010). Deliberate practice is necessary but not sufficient to explain individual differences in piano sight-reading skill: The role of working memory capacity. *Psychological Science, 21*(7), 914–919.

Miller, B. J. (2013). Music learning through video games and apps: Guitar Hero, Rock Band, amplitude, frequency, and Rocksmith, and bandfuse, and bit. Trip complete, and audiosurf, and beat hazard, and biophilia. *American Music, 31*(4), 511–514.

Müllensiefen, D., Gingras, B., Musil, J., & Stewart, L. (2014). The musicality of non-musicians: An index for assessing musical sophistication in the general population. *PlOS ONE, 9*(2), e89642.

Nebel, S., Schneider, S., & Rey, G. D. (2016). From duels to classroom competition: Social competition and learning in educational videogames within different group sizes. *Computers in Human Behavior, 55*, 384–398.

O'Meara, D. (2016). Rocksmith and the shaping of player experience. In M. Austin (Ed.), *Music video games*, 229–49 (pp. 229, 243). Bloomsbury Academic

O'Neill, S. A. (1997). The role of practice in children's early musical performance achievement. In H. Jorgensen and A. C. Lehmann (Eds.), *Does practice make perfect? Current theory and research on instrumental music practice* (pp. 53–70). Norges musikkhøgskole.

Paule-Ruiz, M., Alvarez-Garcia, V., Perez-Perez, J. R., Alvarez-Sierra, M., & Trespalacios-Menendez, F. (2017). Music learning in preschool with mobile devices. *Behaviour & Information Technology, 36*(1), 95–111. https://doi.org/10.1080/0144929x.2016.1198421

Platz, F., Kopiez, R., Lehmann, A. C., & Wolf, A. (2014). The influence of deliberate practice on musical achievement: A meta-analysis. *Frontiers in Psychology, 5*, 646.

Ross-McGill, H., Hewison, J., Hirst, J., Dowswell, T., Holt, A., Brunskill, P., & Thornton, J. (2000). Antenatal home blood pressure monitoring: A pilot randomised controlled trial. *BJOG: An International Journal of Obstetrics & Gynaecology, 107*(2), 217–221.

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality, 63*(3), 397–427.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68–78.

Sansone, C., & Harackiewicz, J. M. (2000). *Intrinsic and extrinsic motivation: The search for optimal motivation and performance*. Elsevier.

Schatt, M. D. (2011). If I have time: Junior high school instrumentalists' attitudes regarding practice. *Visions of Research in Music Education, 19*, 1938–2065.

Schell, J. (2010, February 18). Design outside the box. *Presentation at DICE (Design, Innovate, Communicate, Entertain)* [Video]. Youtube. https://www.youtube.com/watch?v=nG_PbHVW5cQ

Skinner, B. F. (1965). *Science and human behavior*. Simon and Schuster.

Sloboda, J. A., Davidson, J. W., Howe, M. J., & Moore, D. G. (1996). The role of practice in the development of performing musicians. *British Journal of Psychology, 87*(2), 287–309.

Zimmerman, B. J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology, 81*(3), 329.

Zimmerman, B. J. (1994). Dimensions of academic self-regulation: A conceptual framework for education. *Self-regulation of learning and performance: Issues and educational applications, 1*, 33–21.

Zimmerman, B. J. (1998). Academic studying and the development of personal skill: A self-regulatory perspective. *Educational Psychologist, 33*(2–3), 73–86.

Appendix

Survey questionnaire (2020). Retrievable from:

https://osf.io/9csvr. Note: A translated version may be requested from the author.