GAMIFICATION IN HIGHER EDUCATION

Factors Influencing the Usage Intensity of a Gamified E-learning Application

MASTER THESIS

Jarmo J. Vleeshouwer
s1384392

University of Twente

Faculty of Behavioural Sciences

Department of Communication Sciences

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Supervisors:

Dr. A.J.A.M. van Deursen

Dr. S.M. Hegner

ABSTRACT

By applying typical game design elements to non-game settings, gamification aims to improve the user experience in terms of fun and engagement. Derived from a growing interest for this phenomenon in the educational area, this study aims to investigate the influence of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Perceived Enjoyment on the Usage Intensity of a gamified e-learning application. In an attempt to do so, an application called InStaQuest was designed using gamification principles and then implemented into a university statistics course for a duration of eight weeks. Data was gathered by means of an online survey as well as through the application itself. Results from a multiple linear regression analysis indicate that the aforementioned constructs together were not capable of explaining the Usage Intensity construct. Effort Expectancy, representing the ease of using the application, did show a significant association with Usage Intensity. This study then seeks to find an explanation for these results, followed by several recommendations for future studies.

Keywords: gamification, UTAUT, technology adoption, e-learning, Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Perceived Enjoyment, Usage Intensity.

INTRODUCTION

During the past few years, games have started to enter the real world. No longer restricted to computers and consoles, games are now motivating people to exercise, work and even study. The social running game Nike Plus, for example, tries to motivate runners by employing game mechanics such as leaderboards, achievements and challenges. Health Month, a social game that helps users to improve their health habits, uses points, badges, and a virtual 'Spin the Wheel' to make diets and fitness more fun. What these examples have in common is that they only use certain elements from video games. This phenomenon is called gamification, and is most commonly defined as the use of game design elements in non-game contexts (Deterding, Dixon, Khaled & Nacke, 2011). By stripping the addictive and engaging game elements from video games and applying them to less engaging activities, gamification aims to improve the user experience in terms of fun and engagement.

Various researchers and practitioners have now begun to examine the opportunities of gamification in the educational environment. After all, it often remains challenging to fully motivate and engage students in educational systems (Lee & Hammer, 2011). It is believed that gamification can help to increase the student's motivation in learning by integrating the engaging strength of video games into study learning tasks and assignments (Nah, Telaprolu, Rallapalli & Venkata, 2013). This thought is not that strange once you consider that many students play video games during their leisure time, be it either on their smartphones, game consoles or desktop computers. Modern students grow up with computers and video games, yet these kinds of technology are rarely found in classrooms. As stated by Erenli (2013), "*young learners of today gain skills and a method to learn using games in their everyday life but have to use other methods to be successful in school or at university*" (p. 1).

The use of video games in classrooms might not sound as something new, as *serious games* have been around for many years. Serious games, however, differ from gamification in terms of scale and purpose. Serious games are full-fledged computer games with serious intentions, usually employing a large amount of resources in terms of game design knowledge and graphics. Gamified applications on the other hand, only use certain playful elements from these games, thus requiring less resources (Deterding et al., 2011; Groh, 2012). Still, one might argue that gamification is already being practiced in schools. Here, the grades that students receive for their tests are the *rewards*, and being promoted to a higher class can be seen as the *next level*. Yet most students would not describe their school activities as playful experiences, most likely because these dynamics differ greatly from the ones that can be found in video games. Nowadays, video game players willingly invest countless of hours into scenarios where they become gradually skilful throughout tailored objectives, often situated in social environments that stimulate cooperation and competition with other players. If students were to approach their learning objectives in a similar fashion, it is easy to imagine why some researchers and practitioners are eager to apply gaming principles to schools and universities.

Given the previously mentioned premises of educational gamification, it is not surprising to see that the interest for this phenomenon is increasing. This is also reflected in the academic context, where the number of articles published on gamification is growing (Hamari, Koivisto & Sarsa, 2014). Still, there is a lot unknown regarding the effective utilization of gamification in education. This is mostly because there are only a handful of studies that have actually designed and tested a gamified e-learning application (e.g., Goehle, 2013; Domínguez et al., 2013). For instance, it is yet unknown which factors influence the individual adoption process of potential users. Once we gain insight into these factors, future gamification practitioners can use this knowledge to establish focus points within their design processes. Therefore, this study will contribute to current literature by answering the following research question:

RQ: Which factors explain the individual adoption of gamification in higher education?

Because the amount of research regarding the adoption of gamification in education has been limited, this study will also take on an exploratory approach. This implies that knowledge is not only gained through quantitative analyses, but also through qualitative results and experiences that are gained throughout the whole project. This information will then be used to guide future gamification adoption studies in determining suitable research methods and designs. In an attempt to answer the research question of this study, we will first discuss the concept of gamification, followed by a review of technology adoption literature. Knowledge from both subjects will then be used to compose a conceptual model that aims to explain adoption behaviours of target users. Following, the method section provides an outline of the research design, as well as a description of the gamified e-learning application that was created specifically for this study. Finally, the results of this study will be presented, followed by a discussion that provides recommendations for future studies.

Theoretical background

Our research question brings forth two concepts that require a theoretical analysis. First, we will discuss the concept of gamification. More specifically, we will discuss the elements and principles of gamification, and how these fit within the context of education. Subsequently, previous literature regarding information technology adoption will be discussed. As a gamified e-learning application can be considered an information technology, this research area should provide us with factors that are likely to influence the adoption decisions of target users. Finally, we will use this knowledge to compose a conceptual model that aims to explain the adoption of a gamified e-learning application.

Principles of Gamification

Gamification is the *use of game design elements in non-game contexts* (Deterding et al., 2011). Although the use of the term gamification can be traced back to 2008 (Terrill, 2008), its widespread adoption started during the second half of 2010 (Deterding et al., 2011). Since then, the amount of research regarding this phenomenon has grown slowly but steadily. Remarkably, there are very few studies that have conducted an empirical experiment with a gamified e-learning application, especially in higher education (Domínguez et al., 2013). Moreover, there seems to be no research focusing on the adoption of gamification in educational settings. Therefore, with the absence of relevant previous research, we will first try to acquire a general understanding of what gamification has to offer in educational environments, and how these benefits can be achieved.

According to Lee and Hammer (2011), there are three areas in which gamification can motivate students to engage more with their study tasks. The first area is the cognitive area, where games provide players with an objective and a set of rules. In order to complete the objective, players need to experiment within the boundaries of those rules. Characteristic to video games, the ultimate objective is divided into smaller tasks or levels, so called *cycles of expertise*. These cycles of expertise allow players to practice and fail, until they eventually gain the skill to complete the task at hand. Here, failure can be seen as *learning something new*, rather than *making a mistake*. In addition, video game players are not only rewarded for completing end goals - they receive rewards for intermediate objectives as well. This can be quite different when compared to traditional learning processes, where students often know the vague long-term objective (i.e., obtaining sufficient knowledge to pass the exam), but they are unsure on how to get there. Thus, in the cognitive area, gamification is able to provide students with clear and reasonable tasks, while providing immediate feedback and rewards throughout the whole learning process.

The second area in which gamification can motivate students is the emotional area. Games can evoke a range of emotional experiences, such as curiosity, joy, and pride (Lee & Hammer, 2011). As mentioned earlier, players experience repeated failure as well. This negative emotion is possible because games provide fast feedback cycles without risking too much. According to the Flow Theory (Nakamura & Csikszentmihalyi, 2013), the key here is to correctly balance the difficulty of the task between anxiety and boredom, which then keeps the player highly motivated with the task at hand (Domínguez et al., 2013). A good example is the famous mobile game *Angry Birds*, which challenges players to shoot birds at a target. Here, a failure means learning something new: aiming the bird high didn't really work out, so perhaps it might be better to aim a bit lower. It doesn't matter how long it takes the player to complete it, because eventually, he or she has gathered the skills to do so. When compared to a study test, the opposite holds true: there are only a few opportunities which are often accompanied with high risks. This can even result in students feeling too much fear of failure, causing performance anxiety during tests that are of great importance for the continuation of their study.

The third and last area in which gamification is able to motivate students is the social area. Gamification offers the possibility for multiple players to interact, compete and work with each other through various forms of online multiplayer mechanisms. For instance, students can interact through digital message boards, compete by making comparisons in leaderboards and collaborate by forming teams with their fellow classmates. These kinds of interactions allow students to take on in-game identities that are different from their offline identity. To illustrate: shy students who might otherwise excel at certain topics, often prefer to stay in the background. With gamification, these students might now stand out, gaining recognition not only from the teacher but also from their fellow classmates. To summarise, the premises of gamification can be found in cognitive, emotional and social areas. It offers new ways of structuring study materials, while also positively influencing the social positions and emotional experiences of the students (Lee & Hammer, 2011).

Now that we have acquired a general understanding of what gamification can contribute to the educational experience of the student, we can begin to look at the more concrete characteristics of gamification. The definition of gamification speaks of *game design elements* in non-game contexts. But what exactly are game design elements? Deterding et al. (2011) describe game design elements as elements that are *characteristic* to games, implying that such elements are significant to gameplay and can be found in- and associated with most video games. In their book *Gamification by Design*, Zichermann and Cunningham (2011) describe five commonly used game elements: points, levels, leaderboards, badges, and challenges.

Points - A central element in games are the points that players can achieve. Points can be used for several purposes, however they are most commonly used to guide players in their progress. Similar to the grades that are to be found in schools, points can be used to tell players how well they have performed on an objective. Furthermore, points can also be used as a currency, for instance to redeem rewards or unlock new content within the game.

Levels – Somewhat similar to points, levels represent progress. They serve as intermediate objectives that are often required to achieve higher-end goals. Ideally, each level should be slightly more difficult than the previous one, therefore matching the increasing skill of the player. Zichermann and Cunningham (2011) suggest that levels should not be linear nor exponential, implying that not every level has the *same* increase in difficulty. By slightly varying the difficulty for each level, players experience different emotions such as pride and confidence.

Leaderboards – The leaderboard often represents the social layer of gamification. By comparing other game elements such as points, levels, and badges, motivation to play is strengthened through forms of competition. A player might feel pride by his or her high ranking and will try to maintain this position on the leaderboard, while others are challenged to beat the players who are currently ranked above them.

Badges – Badges graphically represent the accomplishment of an objective. There are several ways in which a badge can produce a positive effect. First and foremost, badges recognize a player's achievement and accomplishment. Second, badges can be employed by players to signal their status to others. The mere act of collecting badges can also be a powerful drive for some players. Finally, some players like badges purely for aesthetic reasons (Zichermann & Cunningham, 2011).

Challenges - Challenges give players direction for what to do in order to make progress within the game. Challenges can be introduced in various forms, such as time pressure, difficulty, and special quests (Nah et al., 2013). Often, multiple challenges exist within a single level. In the earlier mentioned game Angry Birds, players advance to the next level by acquiring at least one out of three stars. Even though the next level has been unlocked, most players will still take on the challenge of obtaining all three stars, therefore repeating the objective with an increase in difficulty.

In many gamification scenarios, these game elements can be applied to existing information systems. An example of such a scenario is the study by Rodrigues, Costa and Oliveira (2013), who studied the effects of a gamified e-banking web application on user acceptance. In the context of education, however, the application of game elements might not be that easy, as there is often no existing information system to apply it to. In such cases, a gamified e-learning application needs to be created that either supports or incorporates the existing learning materials. The question remains however, why students would make use of such an application. What is in it for them? In the study "Gamification of Education Using Computer Games", Nah et al. (2013) propose a gamification framework which includes five principles of gamification. These five principles explain how gamification can contribute to the traditional learning processes, and will therefore be discussed next.

Goal Orientation – Study assignments and tests often cover a large quantity of study materials. Goal Orientation aims to structure this amount of information by presenting the player with various layers of goals. For instance, a player faces the short-term goal of answering multiple-choice questions, which rewards him or her with points. Upon receiving enough points, the player will unlock a new level: the medium-term goal. When the player reaches the highest level, the long-term goal is achieved and he or she might receive a badge or unlock new content within the game. As the player advances through different layers of goals, the difficulty of the objectives increases. According to Nah et al. (2013), "*player engagement is sustained by balancing the player's knowledge and skills with the challenge required to advance in the game*" (p. 100). This is related to the concept of flow, which occurs when the mind and body are optimally focused and involved with the task at hand. Flow can be achieved by presenting goals that meet the level of knowledge and skills of the player (Nakamura & Csikszentmihalyi, 2008). Stated differently, players should neither be underchallanged nor overchallenged when trying to complete a challenge (Groh, 2012).

Achievement – Gamification recognizes the achievements of players by presenting them with game elements such as points and badges. When players are rewarded for completing challenges, their sense of gratification increases which then further strengthens their motivation to play (Nah et al., 2013). In the context of education, the achievements of students are often only recognized by their final grades. Gamification is able to recognize students for their intermediate goals as well, stimulating gratification throughout the whole learning process.

Reinforcement – Whether it is at home, at school or in video games, learning takes place through reinforcement. In gamification, reinforcement aims to stimulate good learning behaviour by presenting the player with rewards. According to Zichermann and Cunningham (2011), the quantity and delivery schedule of these rewards determine the level of engagement of the player. The authors speak of *operant conditioning*, which implies a reward system where users do not know how and when rewards will show up. This results in players actively participating in the game, eagerly anticipating that goal completions bring something unexpected. Next to rewards, players should also receive feedback which informs them where they are located in their progress towards achieving their long-term goals. It can help students understand the progress that they have made so far, which otherwise might have been invisible due to the length and complexity of the study materials.

Competition – Games can motivate players through intrinsic rewards and competitive engagement (McGonical, 2011). When a player beats another player in a game, the feeling of joy and pride comes from within: an intrinsic reward. Gamification is able to create these intrinsic rewards by making comparisons using various game elements. Points, levels, badges, and completed challenges can be compared through leaderboards. Competition can also have a downside when employed incorrectly. Some players who are on the losing side might prefer to stay out of the spotlight. This should be taken into account during the design process, for instance by only displaying the scores of the ten highest ranking players.

Fun Orientation – When a game is not considered fun, chances are that no one will play it. According to Zichermann and Cunningham (2011), this is the biggest problem in educational software, where education comes first and fun comes second. As stated by Nah et al. (2013), "*when one is experiencing fun with a game, one can become so engaged in the task the one loses track of time*" (p. 101). Thus, in order for gamification to succeed, it should be considered as a fun activity. This looks somewhat problematic, as different players have different views regarding what is 'fun' in games. Luckily, Lazzaro (2004) performed a study titled 'Why We Play Games', and found four different kinds of fun that people experience while playing games.

The first type of fun is called Hard Fun, which is the fun a player experiences when he or she is overcoming obstacles towards the pursuit of a meaningful challenge. Hard Fun is experienced when skills are required rather than luck. Evidently, Hard Fun can be triggered by completing difficult challenges and reaching higher levels in the game. Easy Fun, the second type of fun, is experienced by players when they explore the system. Players who seek Easy Fun do not aim to win, instead they want to feel excitement, curiosity and adventure along the way. Unexpected badges and an interesting storyline are ways in which Easy Fun can be stimulated. The third kind of fun is called Altered state Fun. Simply put, this type of fun changes the way a player feels. People who play games to experience Altered state Fun want to think or feel something different. According to Lazzaro (2004), the Altered state Fun can also be experienced during games when players feel that they are being good at something that matters. This seems to suggest that Altered state Fun can be triggered throughout the whole gamification experience when students perceive it as a useful activity. Finally, Lazzaro (2004) describes Social Fun, which is the fun that players experience when they engage with other players. Game elements such as the leaderboard can be used to trigger Social Fun.

Adoption of Information Systems

This study aims to explain why students will or will not adopt gamified e-learning applications. In the previous section, we discussed the principles of gamification and how these can contribute to the educational environment. In this section, we will review the information technology adoption literature, which aims to explain why individuals choose to (not) adopt information technologies. Relevant factors derived from these studies will then be used to compose a conceptual model.

Many research models that can be found in today's information technology adoption literature include variables that are derived from Rogers's (1962) attributes of innovations. In his work, Rogers identified five characteristics of innovations that explain the rate at which innovations are adopted by members of a social system. These five characteristics are defined as follows:

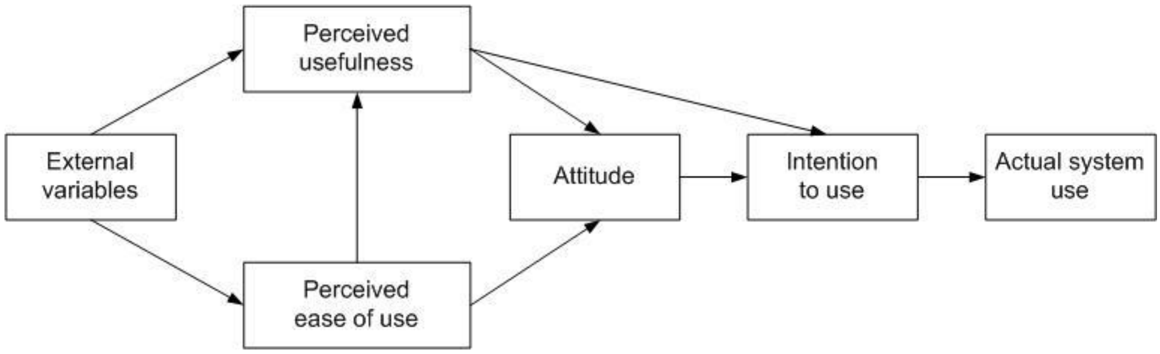
- **Relative advantage**: the extent to which an innovation is perceived as being better than its precursor;
- **Compatibility**: the degree to which an innovation is perceived as being consistent with the existing values, needs and past experiences of potential users;
- **Complexity**: the degree to which an innovation is perceived as difficult to understand and complex to use;
- **Trialability**: the degree to which an innovation may be experimented with before adoption;
- **Observability**: the degree to which the use and effects of an innovation are observable to others.

Moore and Benbasat (1991) argued that the above definitions are based upon perceptions and are not taking the actual *use* of the innovation into consideration. Therefore, they advised to recast the definitions in terms of usage. The definition of Complexity, for example, resulted in *the degree to which using an innovation is difficult to understand and complex to use.* As a result, all characteristics were redefined in terms of using the innovation, and labelled as the *Perceived Characteristics of Innovating (PCI)*. Based upon other research, Moore and Benbasat (1991) also added two other variables to the PCI:

- **Image**: the degree to which the use of an innovation is perceived to enhance one's image or status;
- **Voluntariness**: the degree to which the use of the innovation is perceived as being voluntary.

In 1986, Davis aimed to explain the intention of users to adopt a new technology by focusing on their *attitude* towards it. This resulted in the Technology Acceptance Model and has since been used in many information technology adoption studies. Adapted from Azjen and Fishbein's Theory of Reasoned Action (1975), the Technology Acceptance Model focusses on two key variables, called Perceived Usefulness and Perceived Ease of Use, which are considered to be similar to Rogers's (1962) attributes Relative Advantage and Complexity respectively. The Technology Acceptance Model (see Figure 1) theorizes that these two variables determine the attitude of an individual towards a technology, which in turn influences their behavioural intention to use it. Perceived Ease of Use is also expected to influence Perceived Usefulness, as Davis hypothesized that a technology that is easy to use becomes more useful as well. Studies that have empirically tested the Technology Acceptance Model found that Perceived Usefulness is often to be a more important determinant than Perceived Ease of Use (Bouwman, van den Hooff, van de Wijngaert & van Dijk, 2002).

■ **Figure 1**. The Technology Acceptance Model (Davis, 1986).

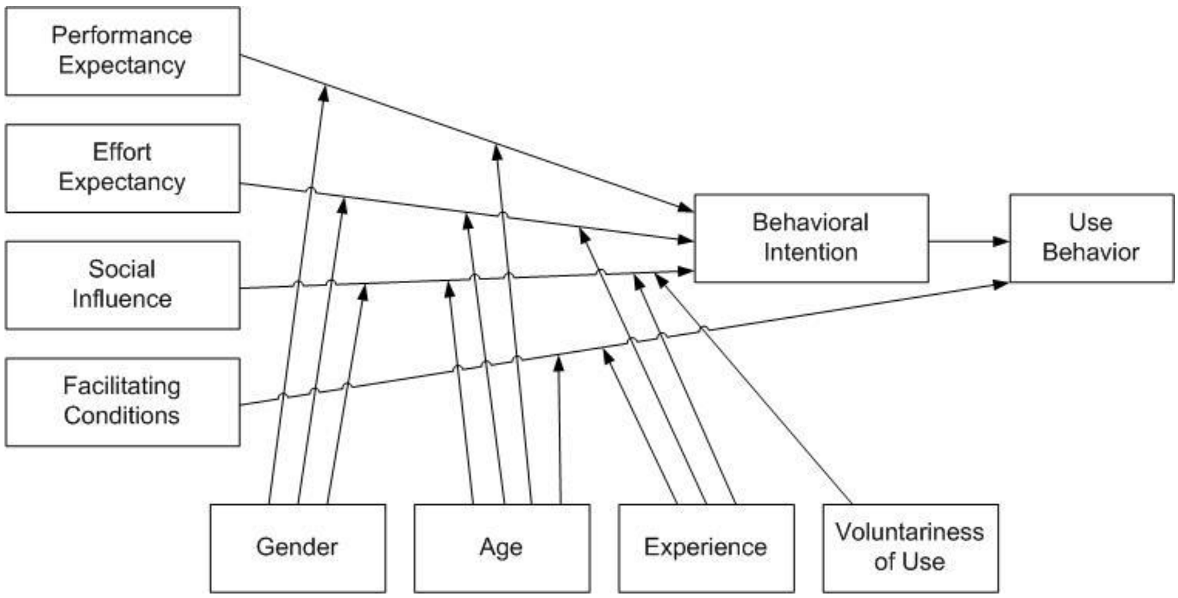


As Figure 1 shows, both Perceived Usefulness and Perceived Ease of Use are influenced by External variables. These variables have been the research goal of many studies that followed the publication of the Technology Acceptance Model. One variable that showed consistent relevance across multiple studies is a user's prior experience with the technology (Bouwman et al., 2002). As one might expect, prior experience with a technology reduces the Perceived Ease of Use, which in turn increases the Perceived Usefulness. Furthermore, if the prior experience with a technology is bad, users are more likely to perceive the technology as less useful as well.

As an extension to the Technology Acceptance Model, Venkatesh and Davis (2000) proposed the Technology Acceptance Model 2, which incorporates additional social influence variables explaining technology adoption. Besides the previously discussed variables *Voluntariness* and *Image*, Venkatesh and Davis also added the variable Subjective Norm to their model, which represents the perceived social pressure from important others to (not) perform a certain behaviour.

Following the Technology Acceptance Model 2, Venkatesh, Morris, David & Davis (2003) reviewed and compared eight user adoption models and united these models into the Unified Theory of Acceptance and Use of Technology (UTAUT). This model (see Figure 2) includes four determinants (Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions) of user acceptance and usage behaviour. These four determinants are furthermore moderated by four variables: Gender, Age, Voluntariness, and Experience.

■ **Figure 2**. Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003).



Venkatesh et al. (2003) defined Performance Expectancy as "*the degree to which an individual believes that using the system will help him or her to attain gains in job performance*". Evidently, Performance Expectancy was derived from the previously mentioned constructs Perceived Usefulness and Relative Advantage. Effort Expectancy, the second direct determinant in UTAUT, was derived from the constructs Complexity and Perceived Ease of Use, and was defined as the degree of ease associated with the use of the new technology. Social Influence was considered to be similar to TAM's Subjective Norm. The last direct determinant, Facilitating Conditions, is defined by Venkatesh et al. (2003) as "*the degree to which an* *individual believes that an organizational and technical infrastructure exists to support use of the system*". Facilitating Conditions incorporates the previously mentioned constructs Compatibility, Observability and Triability.

Since its publication in 2003, the UTAUT model has become a popular model in the field of information technology adoption. This is not without reason, as the model has received empirical support for different kinds of technology uses. To give some examples, the UTAUT model has been able to explain the adoption of information kiosks (Wang & Shih, 2009), small and medium enterprises (Mursalin, 2012), internet banking (AbuShanab & Pearson, 2007) and electronic library systems (Oluchi, 2010). In addition, other studies have shown that the UTAUT model is robust enough to withstand cultural differences (Oshlyansky, Cairns & Thimbleby, 2007; Nistor, Gögüs & Lerche, 2013) However to this date, there have been no studies to test the UTAUT model with a gamified e-learning application. Therefore, we need to ask ourselves: how does the UTAUT model fit within the context of gamification? Looking at the four UTAUT constructs in Figure 2, there seems to be no reason to expect that the UTAUT model is not capable of predicting the adoption of gamified e-learning applications. Performance Expectancy is expected to play an important role, as a gamification application that has no benefits over traditional study materials is not likely to be used by students. The same can be said about Effort Expectancy: when the gamified e-learning application is too difficult to use, adoption is less likely to occur. Since gamification incorporates social elements as well, UTAUT's Social Influence also seems to be a good match. Lastly, we expect to see that Facilitating Conditions is also relevant, as a lack of support (be it either organizational or technical) will likely hinder the use of gamified e-learning applications.

Up to now, it seems that the four constructs of the UTAUT model are applicable to gamification. Still, one might argue that the model does not cover all the aspects of gamification. Especially the hedonic characteristic of gamification, *increasing engagement through game elements*, does not seem to be treated by the model. Do adoption factors differ between hedonic and utilitarian systems? According to van der Heijden (2004), the value of a hedonic system is to have a self-fulfilling, pleasurable experience, whereas utilitarian systems aim to provide instrumental values. Furthermore, van der Heijden describes hedonic applications as aesthetically appealing with the objective to encourage prolonged use. Although the ultimate goal of gamification might be of instrumental value (e.g., an improvement in study performance), the means of achieving such values are actually through playful game dynamics that users experience. Thus, a gamification user is more likely to assess the application based on its hedonic features rather than on its utilitarian features. Furthermore, when game dynamics become the main driver for using gamified applications, users might not even consider the beneficial outcomes. Hence, we believe that the hedonic features of gamification are more prevalent in user assessments of gamification compared to utilitarian characteristics.

Results from van der Heijden's (2004) study show that *Perceived Enjoyment* is a strong determinant for the usage of hedonic systems. This is in line with the study by Lin and Bhattacherjee (2007), who suggest that Perceived Enjoyment "*should have a stronger effect on user attitudes towards hedonic systems because the expressed intent of such systems is to maximize user's enjoyment or entertainment from their use*" (p. 5). In addition, the authors suggest that Perceived Usefulness and Perceived Ease of Use are less relevant for hedonic systems as the goal of these systems is not to improve practical outcomes. By adding Perceived Enjoyment to the four constructs of the UTAUT model (Figure 2), we now have five potential constructs that explain the adoption of gamified e-learning applications.

Usage Intensity

An important aspect of gamification are the social dynamics between players. For some players, being rewarded with points, badges or achievements provides sufficient motivation to keep playing. Others might prefer forms of social recognition, which can be earned through the social game dynamics cooperation and competition. One might argue that, without a solid user base, gamification will not become truly useful. Students who try to reach the highest scores on challenges might lose interest once they find out that none of the other classmates are participating. Rewards for reaching higher levels lose their value when there are only a few other users to show them to. In other words, a sufficient amount of users is needed in order for gamification to become truly successful. This is related to the concept of *critical mass*, which implies that a technology is only interesting to the majority of potential users when there are already enough users working with that technology (Rogers, 1962). As a consequence, adoption of potential users is crucial. However, one might wonder if adoption is the appropriate dependent variable to represent the effectiveness of a gamification application. After all, a fully engaged user differs from an occasional user, even though both have adopted the application.

Following Corrocher's (2011) line of thought, the *usage intensity* might be a preferable construct, as it covers all the activities that users perform in order to benefit from the adopted innovation. Usage Intensity can be measured using digital metrics from the gamified e-learning application itself, such as the frequency of use, the depth of use, and the amount of activities performed. Merging these values into an overall Usage Intensity score gives u a better understanding about the degree of adoption, compared to a situation where students either *do* or *do not* choose to adopt.

Constructs of the Conceptual Model

We currently have five constructs (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Perceived Enjoyment) that are likely to influence our dependent variable, Usage Intensity. In the remainder of this chapter, these constructs and their interrelationships will be discussed in greater detail. Additionally, we will add two moderating variables to our study: Age and Experience.

Performance Expectancy - In the context of this research, Performance Expectancy is defined as *the degree to which a student perceives that using the gamified e-learning application will enhance his or her study performance*. In line with the UTAUT model (Venkatesh et al., 2003), we expect Performance Expectancy to positively contribute to Usage Intensity, as technologies that are perceived as more useful are likely to be used more as well. Stated differently, students who believe that the gamified e-learning application is capable of enhancing their study performance will use the application to a greater extent, compared to students who hold the opposite supposition. Therefore, the following hypothesis is proposed:

H1: Performance Expectancy positively contributes to Usage Intensity.

Effort Expectancy – Effort Expectancy is defined as *the degree to which a student perceives that using the gamified e-learning application is effortless* (derived from Davis, 1986). We expect that Effort Expectancy positively contributes to Usage Intensity, as technologies that are easy to use are likely to be used more frequently compared to technologies that are difficult to use. Furthermore, in line with the Technology Acceptance Model (Davis, 1986) and other related studies (e.g., Hsu & Lu, 2004; van der Heijden, 2004; Bruner & Kumar, 2005; Chesney, 2006), we expect Effort Expectancy to positively contribute to Performance Expectancy, as technologies that are easy to use should become more useful as well. When the gamification application is too difficult to use, students are less likely to receive benefits from it. In line with previous related studies (e.g., van der Heijden, 2004; Sun & Zhang, 2006; Chesney, 2006), we furthermore expect Effort Expectancy to positively contribute to Perceived Enjoyment. When the gamification application is too difficult to use, frustrations may arise, thus influencing the user satisfaction. As a result, the following three hypotheses are proposed:

H2a: Effort Expectancy positively contributes to Usage Intensity.

H2b: Effort Expectancy positively contributes to Performance Expectancy.

H2c: Effort Expectancy positively contributes to Perceived Enjoyment.

Social Influence – Venkatesh et al. (2003) define Social Influence as "*the degree to which an individual perceives that important others believe he or she should use the new system*" (p. 451). Within the context of this study, we believe that these important others are the fellow classmates and teachers of the student. When social influences are high, students feel pressure to adopt, for instance because a vast majority of the students is already participating. Likewise, when Social Influence is low, other students might openly disapprove the application, therefore negatively influencing the adoption decision of others. As a result, we propose the following hypothesis:

H3: Social Influence positively contributes to Usage Intensity.

Facilitating Conditions – Derived from the UTAUT model (Venkatesh et al., 2003), Facilitating Conditions represents *the degree to which a student believes that an organizational and technical infrastructure exists to support the use of the gamified e-learning application*. When Facilitating Conditions is low, students experience barriers that hinder the usage of the application. These barriers can be either organizational (e.g., no introduction, training or support) or technical (e.g., no internet access, errors present in the application). In line with the UTAUT model, we expect to see that as Facilitating Conditions increases, the Usage Intensity increases as well. Furthermore, we expect that Facilitating Conditions positively contributes to Performance Expectancy, since organizational and technical barriers are likely to delay results. Therefore, the following two hypotheses are proposed:

H4a: Facilitating Conditions positively contributes to Usage Intensity.

H4b: Facilitating Conditions positively contributes to Performance Expectancy.

Perceived Enjoyment - Perceived Enjoyment is defined as *the degree to which a student perceives the use of the gamified e-learning application to be enjoyable or pleasant*. Perceived Enjoyment distinguishes from Performance Expectancy in terms of extrinsic and intrinsic motivation. Performance Expectancy represents motivators that are external to the interaction with the application, i.e., an improvement in study performance. Perceived Enjoyment, on the other hand, focuses on intrinsic motivation, such as the feelings of joy that students might experience when using the application (van der Heijden, 2004). We expect that Perceived Enjoyment is positively associated with the Usage Intensity of the gamified e-learning application, since gamification tries to motivate users by adding the ‘fun ingredient’ to less appealing activities. It is expected, that as the application is perceived as more enjoyable, the use of the application increases as well. Therefore, the following hypothesis is proposed:

H5: Perceived Enjoyment positively contributes to Usage Intensity.

Moderating Constructs – In addition to the five aforementioned predictors of technology adoption, the UTAUT model as depicted in Figure 2 also includes four moderating factors: Gender, Age, Experience, and Voluntariness. These will be discussed next.

Gender – Do we expect differences in usage intensity between men and women? Previous studies regarding technology adoption suggest that the usefulness of a system is more important to men, whereas women tend to focus more on its ease of use (Morris & Venkatesh, 2000; Kim, 2010; Terzis & Economides, 2011; Padilla-Meléndez, del Aguila-Obra, & Garrido-Moreno, 2013). In addition, the UTAUT model states that women are influenced more strongly by other people's opinions with regard to information technology usage (Venkatesh et al., 2003). Thus, the following three hypotheses will be tested:

H6a: Performance Expectancy will contribute to Usage Intensity more strongly for men than it will for women.

H6b: Effort Expectancy will contribute to Usage Intensity more strongly for women than it will for men.

H6c: Social Influence will contribute to Usage Intensity more strongly for women than it will for men.

Age –Previous studies have shown that age plays a moderating role in the adoption of information technologies. Venkatesh et al. (2003) found that older people attach more meaning to Facilitating Conditions and Effort Expectancy, whereas younger people find Performance Expectancy to be of greater importance. If we were to test the moderating effects of age, a sample is needed that covers a widespread of different ages. Unfortunately this is not the case for this current study, as a gamified e-learning application will be implemented into a university course. Because this makes it practically impossible to study the effects of age on the adoption of gamification, we will not include this moderating variable into our study.

Experience – Various information technology adoption studies have included *experience* as a moderating variable, however there appears to be inconsistency regarding its conceptualization. In some studies, such as the study by Venkatesh et al. (2003), experience represents the increase in familiarity and knowledge with the technology that is being studied. In these cases, experience is measured at different stages of use, for instance by using time intervals of several weeks. Other studies include experience as a moderating variable to represent a user's *prior experience* with the technology. Here, experience is a fixed variable that captures the level of familiarity and knowledge users have with the technology in general (Sun & Zhang, 2005). In the context of gamified e-learning, we believe that both representations of experience are of interest. As demonstrated by Venkatesh et al., Effort Expectancy and Facilitating Conditions are assessed by users more heavily during the early stages of technology use. The idea behind this is that difficulty and usage barriers are likely to decrease as experience with technology increases. As much as we would like to test these effects, the length of a single academic course is rather short, causing the different stages of use to be too close to each other. Instead, we will test experience as a representation of a student's prior experience with the technology. This means that we first need to determine what kind of technology that is. One's first notion would be to use gamified e-learning applications as a reference point, however as gamification is still hardly being practiced at schools and universities, we believe this notion will not hold. Instead, we believe that *experience with video games* is a better fit, as gamification incorporates game design elements that are familiar to most video game players. This idea is in accordance with Goehle (2013), who found that "*students who play video games regularly were more engaged with our gamification techniques*" (p. 243). Students who play video games for entertainment purposes will recognize the familiar game design elements in gamification practices, which may lead to an increase in appreciation for the gamified application. Hence, the following hypothesis is proposed:

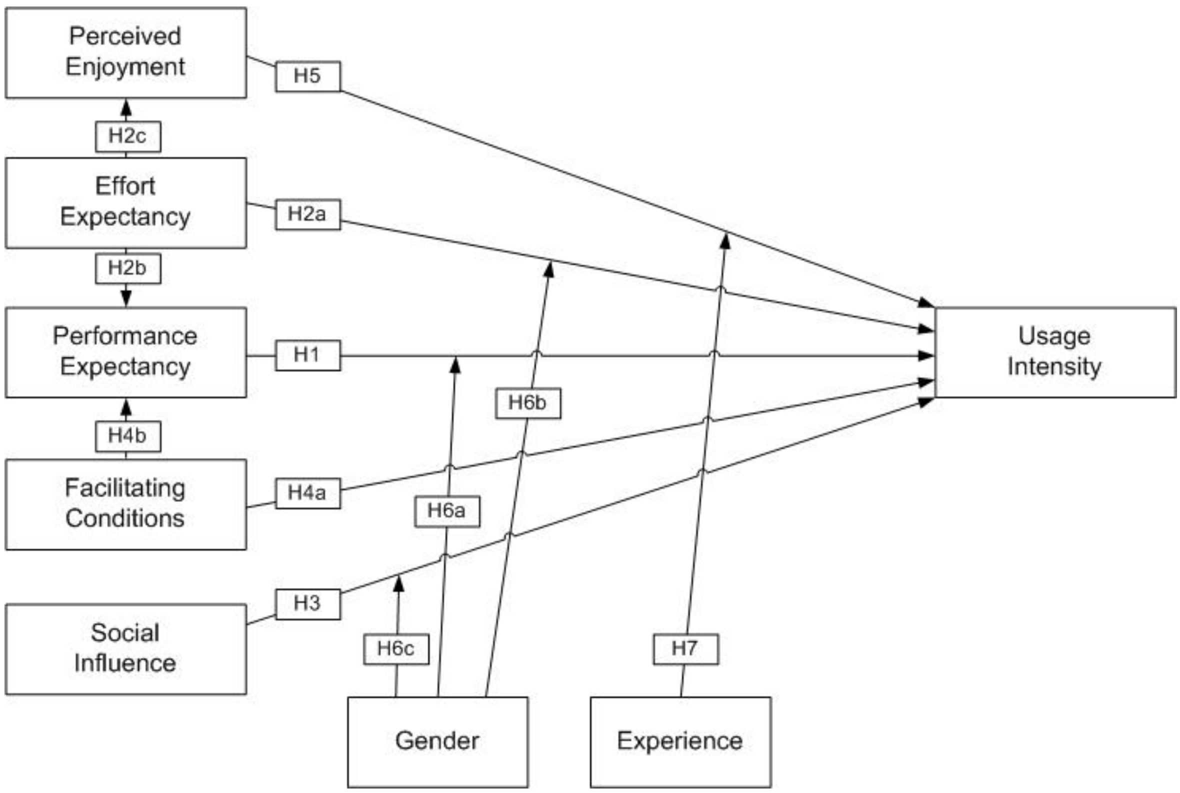
H7: Perceived Enjoyment will contribute to Usage Intensity more strongly for students who regularly play video games compared to students who do not.

Voluntariness – The fourth and last moderating variable of the UTAUT model is *voluntariness of use*, which distinguishes voluntary and mandatory information technology usage. In voluntary settings, target users are free to decide whether they will or will not adopt a certain technology, whereas in mandatory settings, adoption is required. This distinction also holds in the educational setting, where some information technologies are obligatory (e.g., the university's course managements tool) while others are not (e.g., the university's library search engine). Venkatesh et al. (2003) found that social influences are only present in mandatory settings, suggesting that compliances (e.g., with bosses and teachers) play a vital role in the adoption decisions of target users. The gamified e-learning application, which will be described in the next section of this article, is of voluntary use, meaning that students are free to decide whether they will or will not use the application. Does this mean that we can remove the Social Influence construct from our model? Perhaps, but this would also rule out any social influences that occur between students. Thus, it seems wise to keep the Social Influence construct in our study. Evidently, because we will not create both a voluntary and mandatory application, comparisons between both settings cannot be made. Instead, this variable needs to be controlled so that students are aware that usage is voluntary.

Conceptual Model

To conclude the theoretical framework, the conceptual model for this study is presented in Figure 3, containing the hypothesized relationships between the constructs. The constructs on the left side are considered to be the direct determinants of usage behaviour, while the two moderators at the bottom are expected to influence the strength of some of these direct determinants. In the next section of this article, the measuring instruments for this model will be discussed. First however, we will discuss the gamified e-learning application that was designed for this study.

■ **Figure 3**. Conceptual Model with Hypothesized Relationships



METHOD

In the first part of the method section, we will describe the design of the interactive website *InStaQuest*, which was created using the gamification principles as discussed in the theoretical background. The second part will cover the research design itself, addressing the sample, procedures and measurements of this study.

Gamification Design

Target group – InStaQuest was designed for an inferential statistics course at the University of Twente. This course, which ran from April till July 2015, was positioned in the pre-master curriculum for multiple behavioural science studies. Roughly 110 students signed up for this course. With a few exceptions, the majority of these students were between the ages of 20 and 28. The use of InStaQuest was not mandatory. Evidently, this was needed to study the factors influencing the adoption decisions of the students. An invitation e-mail was sent to all course participating students at the start of the statistics course. This e-mail, which invited all students to participate in the project, also underlined that the use of InStaQuest was not mandatory. The voluntariness of use was again mentioned after students logged in to the website for the first time.

Technical – InStaQuest was built using web-programming languages HTML, CSS, and PHP. The website was hosted online, enabling students to access the application at any time and place. Students received their personal login credentials in an invitation e-mail that was sent at the start of the statistics course. To create additional project awareness amongst the students, announcements were posted on Blackboard (the electronic learning and course management environment used by the university). The design of the website was made responsive, so that it could be accessed and viewed properly on different devices (i.e.: desktop computers, tablets, and smartphones).

Main features – InStaQuest consisted of two main features: the *practice environment* and the *play environment*. In the practice environment (see Appendix B.1. and B.2. for screenshots), students had to complete levels that included ten multiple choice questions. In order to complete a level, students had to earn at least one star, which required them to answer six out of ten questions correctly. Two stars were earned by correctly answering eight questions, whereas three stars were given to those that could answer all questions correctly. Each level covered more study material, thus increasing the difficulty one step at a time.

The play environment included a murder mystery game, in which players had to solve a murder on the fictional '*Fisher Island*' (see Appendix B.3.). In order to obtain clues, players had to travel around the island, completing statistical quests at different cities. Upon acquiring all clues, players were able to identify the murderer.

Gamification principles – Below, we will describe how gamification was applied to InStaQuest by discussing each of the five principles of gamification: goal orientation, achievement, reinforcement, competition, and fun orientation.

- Goal orientation aims to structure information in various goal layers. This principle was most visible in the practice feature, where the study materials of the course were divided into five subjects. Each subject contained three levels, with each level being slightly more difficult than the previous one. The final level in the practice area covered all the study materials, thus giving the students the opportunity to test their overall knowledge of the course.
- Reinforcement aims to stimulate learning behaviour by presenting the player with rewards. There were three types of rewards to be achieved in InStaQuest: experience points, coins, and clues. Experience points determined a player's level and were acquired by participation itself: activities such as completing practice levels or traveling

from one city to another gave the player experience points. The player level and the amount of acquired experience points were visible in the progress bar, located at the top of every page. The second type of reward that could be achieved in InStaQuest were coins, which served as a currency within the play environment. Coins were acquired by completing practice levels and were needed to travel around Fisher Island. Lastly, clues were earned by completing quests in the play environment, and were needed to solve the murder mystery game.

- Competition was employed by comparing experience points and coins through leaderboards. The main leaderboard, which was located on the home page of the website, listed the top five players in terms of experience points. The group leaderboards, located in the play environment, made comparisons in experience points and coins between the different studies, thus stimulating a form of cooperation as well.
- Achievements give recognition to players for completing (intermediate) goals. Whenever a player completed a level or quest, their achievement was displayed in the ‘Recent Activities’ window, located on the home page of InStaQuest. A different type of achievement was a player’s level, which increased by receiving experience points through general participation. Early on, students levelled up quite fast, however the amount of experience points needed to level up increased with every level. Finally, the group leaderboards also displayed the top contributors of every group, therefore recognizing players who contributed the most.
- Fun is an important part of gamification, yet it is perhaps also the most difficult principle to design. In the theory section of this article, we discussed four different types of fun: Hard Fun (becoming skilled at the task at hand), Easy Fun (feeling excitement, curiosity and adventure through exploration), Altered State Fun (changing the way a player feels or thinks) and Social Fun (engaging with others). We believe that all four types of fun

were to be found in InStaQuest: Hard Fun could be experienced by progressing in the practice environment (i.e., trying to get the maximum score for each level), Easy Fun could be experienced by exploring the play environment (i.e., traveling around Fisher Island), Altered State Fun could be experienced by taking on the role as a detective in the murder mystery game, and lastly, Social Fun could be experienced through the competitive and cooperative game elements found in the leaderboards.

Research design

Procedure – InStaQuest was positioned in an inferential statistics course that ran for approximately eight weeks. The initial procedure was to measure the five constructs using the InStaQuest website itself, however as the amount of participants turned out to be less than expected, we decided to use an online survey tool instead. This enabled us to acquire perceptions about InStaQuest from the non-users (students who had not participated in InStaQuest) as well, therefore increasing the sample size. A downside to this approach however, was that the non-users only received a general description of the gamified e-learning application, whereas the users had actually interacted with the website.

Online Survey – After InStaQuest had run its course, all course participating students received a survey invitation (n = 114). This survey started with a question that asked students whether they had or had not participated in InStaQuest. This distinction between users and non-users made it possible to create side branches within the online survey. To illustrate: non-users received a general description of the website, whereas users did not. Likewise, statements could be phrased differently: users read '*InStaQuest improved my study performance'* whereas non-users read '*InStaQuest would have improved my study performance*'. Finally, in contrast to users, non-users were asked about their motives to not adopt InStaQuest.

The four constructs derived from the UTAUT model (Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions) were measured using their original item scales. Participants were asked to evaluate these items using a five-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree’. Evidently, the item scales needed to be slightly adapted to better fit the technology of this study (see Appendix A). Similar to the rest of the survey, all items were formulated in English. The fifth construct, Perceived Enjoyment, was measured in a similar way, using items derived from Davis (1992) and Venkatesh (2000). To increase the validity across the item scales, several items were formulated negatively.

Following the item scales, non-users were asked about their motives for non-adoption. A four-point Likert scale (To a great extent, Somewhat, Very little, Not at all) was used to weigh the importance of the following eight motives: lack of interest or motivation, lack of information, dislike of technology, dislike of method, lack of skills or confidence, insufficient time, privacy, and technical issues. To ensure that all motives were captured, participants were able to add their own motive as well, though none were given.

Three items in our online survey measured the moderating variable Experience, which distinguishes students who regularly play video games from those that do not. The first item asked survey respondents about the amount of years they have been playing video games, followed by a similar question that asked respondents about the average time they play video games per day. The third item asked participants to label themselves as either a *non-gamer, casual gamer, regular gamer,* or *hardcore gamer*. These three items were later used to make a distinction between students who regularly play videogames (referred to as *gamers*) and those who do not (referred to as *non-gamers*). Finally, all survey respondents were given the opportunity to provide general feedback regarding this project. These student responses can be found in Appendix C.

Reliability - The reliability of the scales used to measure the five constructs are presented in Table 1. With the exception of Social Influence, we believe the remaining item scales to be reliable, as they are based upon the well-established item scales from the UTAUT model. The Cronbach's Alpha's below 0.7 are likely to be the result of the low number of items used for those scales (Lance, Butts & Michels, 2006).

Upon closer inspection of the Social Influence construct, we found that the item '*My fellow students thought using InStaQuest was a bad idea*' did not correlate well with the other statements measuring Social Influence. The reason for this was a contradiction within the item scale: the aforementioned statement focused on fellow students, whereas the other items focused on teachers and the university in general. As a result, we decided to divide the Social Influence scale between the two social groups, resulting in a 'Social Influence (Students)' construct and a 'Social Influence (University)' construct. The former construct only encompassed the '*My fellow students though using InStaQuest was a bad idea*' item, whereas the latter encompassed the remaining three Social Influence items.

Table 1.

Construct Reliability

Construct	***n***	***α***
Performance Expectancy	4	0.839
Effort Expectancy	4	0.738
Facilitating Conditions	4	0.651
Perceived Enjoyment	4	0.817
Social Influence	4	0.545
Social Influence (Students)	1	-
Social Influence (University)	3	0.663

Dependent Variable – The dependent variable of this study, Usage Intensity, was measured using three website statistics: amount of logins, amount of activities performed, and the depth of use. The first two statistics could be easily measured by the website's database: each time a user logged in or performed an activity, a count would be updated in the database. The depth of use referred to the type of activities students performed in InStaQuest. As mentioned earlier, InStaQuest consisted of two main features: the practice environment and the play environment. The practice environment was the most easily accessible feature of the website: after logging in, students could start right off the bat without any further instructions necessary. The play environment on the other hand, took some time and understanding (i.e., reading the storyline and learning the controls), thus representing the deeper layer of the website.

The amount of logins and activities performed by the users were transformed in categorical variables using their quartiles (see Table 2). To give equal weight to the Depth of Use variable, value 2 was given to players who only performed activities in the practice environment, whereas value 4 was given to players who participated in the play environment. Finally, the Usage Intensity could be calculated using the following formula: *Usage Intensity = (Logins + Activities + Depth of Use) / 12*. This formula gave each respondent a Usage Intensity score between 0 and 1, where a higher score referred to a higher degree of usage.

Table 2.

Values used to compute the Usage Intensity construct

Value	Amount of Logins	Amount of Activities	Depth of Use
0	Zero (non-users)	Zero (non-users)	Zero (non-users)
1	min – Q1	min – Q1	
2	Q1 – Q2	Q1 – Q2	Practice environment
3	Q2 – Q3	Q2 – Q3	
4	Q3 - max	Q3 - max	Play environment

Note: Q1 = first quartile, Q2 = second quartile, Q3 = third quartile.

Sample – A total of 114 survey invitations were sent, equal to the amount of students that were enrolled for the statistics course. From this group, 65 students participated in the online survey. Four students did not complete the survey, resulting in a final sample of 61 respondents (27 men and 34 women). Respondent ages ranged from 20 to 48 (M = 24.92, SD = 4.51). From the 61 respondents who filled in the online survey, 27 indicated that they had used InStaQuest, whereas 34 did not (see Table 3). This number matches with our database, thus it is safe to say that out of the 114 students who formed the target group of InStaQuest, 27 had actually adopted the application. With regard to the Prior Experience construct, our sample included 32 students who play video games on a regular basis, compared to 29 who do not.

Table 3.

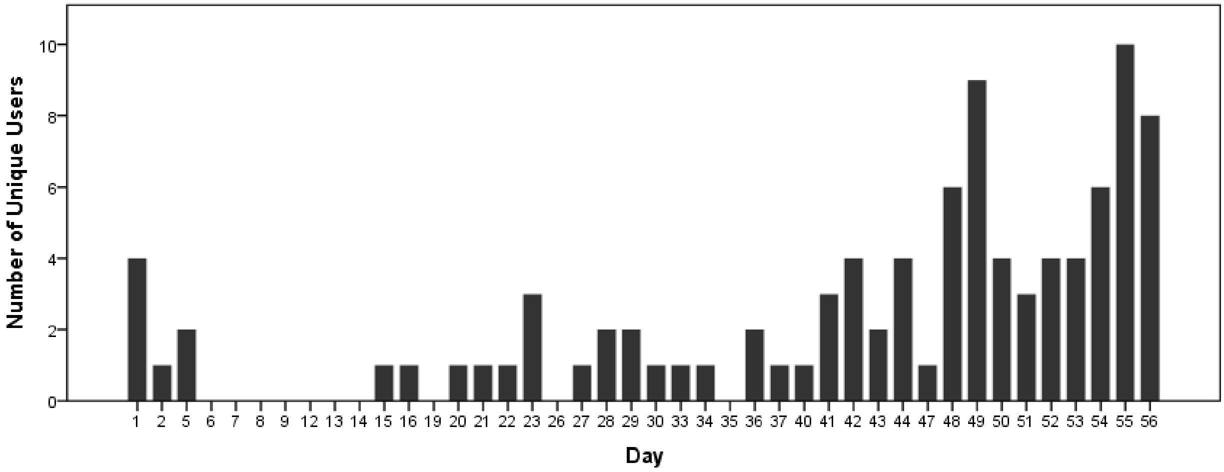
Sample Composition

	Users (*n* = 27)	**Non-users** (*n* = 34)
Males (*n* = 27)		
n	14	13
Age	24.07 (*SD* = 1.54)	26.31 (*SD* = 6.87)
Prior Experience	11	11
Females (*n* = 34)		
n	13	21
Age	23.00 (*SD* = 1.41)	25.81 (*SD* = 5.00)
Prior Experience	4	6
Total (*n* = 61)		
n	27	34
Age	25.15 (*SD* = 4.93)	24.74 (*SD* = 4.22)
Prior Experience	15	17

Data Analysis - To test the conceptual model as presented in Figure 3, a multiple linear regression was conducted using IBM SPSS statistical software. Because of the positive skewness of the data (due to a lot of zero values representing the non-users), a logarithmic transformation regarding the Usage Intensity construct was carried out first. This slightly reduced the skewness value from 0.882 (*SD* = 0.306) to 0.693 (*SD* = 0.306). To examine the influence of the moderating variables on the relationships between the dependent and independent variables of the conceptual model, moderator analysis were performed using centralization methods. This implies having both the independent and moderator variables centred and then multiplied with each other to create interaction terms. Linear regression was then used to see if these terms influenced the Usage Intensity construct.

Usage Flow - Before we will discuss the results of this study, we would first like to address the usage flow of this project. As mentioned earlier, the number of participating students turned out to be less than expected. Especially during the first few weeks, there were only a few users active on InStaQuest. The usage flow is illustrated in Figure 4, in which the number of users per day is displayed. We excluded Saturdays and Sundays from this graph, as we did not expect students to be active during the weekends (which was also visible in our data). The numbers displayed are unique numbers, therefore excluding multiple logins by the same student.

■ **Figure 4**. Usage Flow – Number of Unique Users per Day



As can be seen in Figure 4, only very few students logged in during the first days of InStaQuest. Participation started to increase roughly two weeks before the exam took place, though mostly in the practice environment. The peak around day 48 can be explained by the addition of an extra feature in the practice environment. The implementation of this new feature, which revolved around matching the appropriate test with a statistical problem, came with an announcement on Blackboard, thus increasing the awareness of the project once more.

■ **Figure 5**. Usage Flow – Number of Activities performed per Day

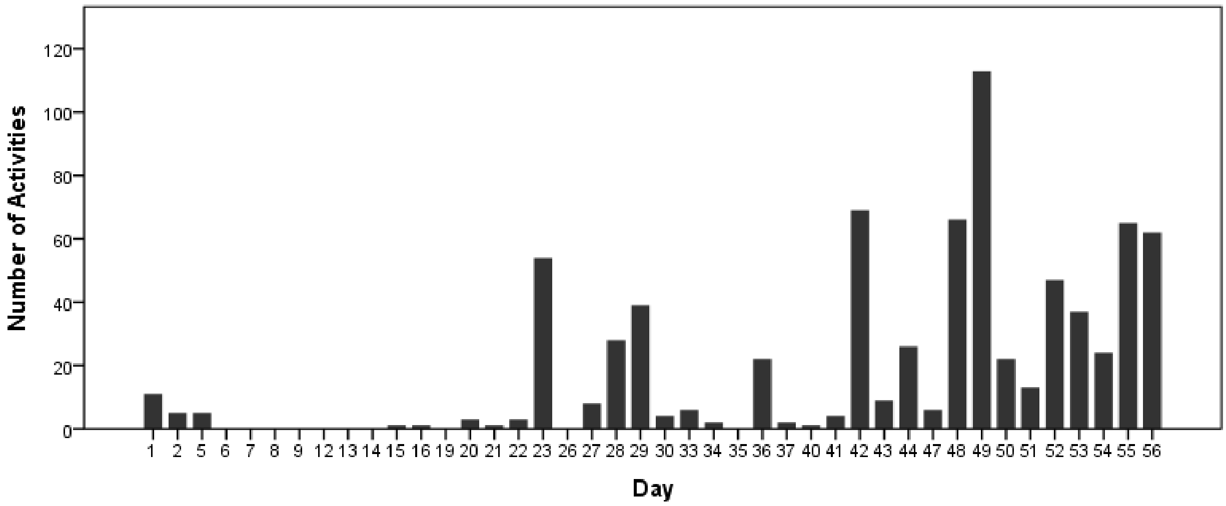


Figure 5 displays the amount of activities performed for each day. Here we see that the addition of the new practice feature on day 48 caused the highest usage peak: nearly 120 activities were performed on that day. Still, both graphs illustrate a low degree of participation. Save for the last two weeks, the amount of different users did not exceed four. It appeared that students perceived InStaQuest as a tool to test their knowledge shortly before the exam took place, rather than a tool to learn and practice their skills along the way.

RESULTS

This study aimed to find factors associated with Usage Intensity of a gamified e-learning application in higher education. A regression analysis was conducted to see if the six constructs (Performance Expectancy, Effort Expectancy, Facilitating Conditions, Social Influence (Students), Social Influence (University) and Perceived Enjoyment) together were able to predict the Usage Intensity of the students. The results are presented in Table 4 and Figure 6. With an R-square of 0.143, we can safely conclude that our regression model is not capable of explaining the variation in the Usage Intensity construct. Looking again at Table 4, we furthermore see that there are no significant relationships between one of the independent variables and the dependent variable Usage Intensity.

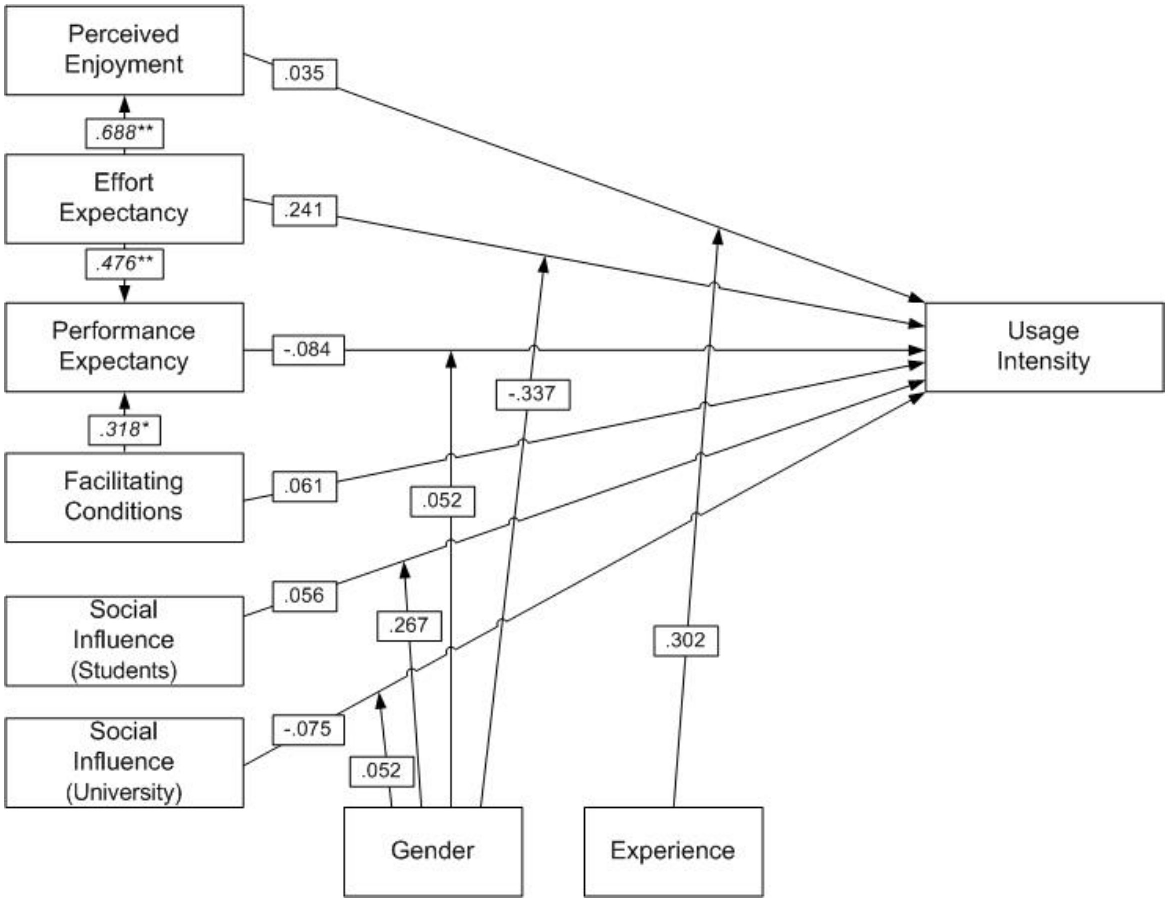
Table 4.

Regression Analysis with Usage Intensity as Dependent Variable

Construct	***β***	***t***	***p***
Performance Expectancy	-0.084	-0.721	0.474
Effort Expectancy	0.241	1.758	0.084
Facilitating Conditions	0.061	0.507	0.614
Perceived Enjoyment	0.035	0.660	0.801
Social Influence (Students)	0.056	-0.829	0.512
Social Influence (University)	-0.075	0.253	0.411
$R^2 = 0.143$			

In addition to performing a regression analysis with the Usage Intensity construct as computed with three components (amount of logins, the amount of activities performed, and the depth of use), regression analyses were performed with two individual components as well. Similar to the regression analysis above, both tests showed no relationship. *Amount of Logins* as dependent variable resulted in an R-square of 0.193, whereas *Amount of Activities Performed* resulted in an R-square of 0.214.

■ **Figure 6**. Conceptual Model with Beta Coefficients



Note: *$p < .05$, **$p < 0.001$.

Table 5 displays the correlation values between the constructs of this study. Performance Expectancy correlates significantly with Effort Expectancy (r = 0.443) and Facilitating Conditions (r = 0.269), therefore supporting hypotheses H2b and H4b respectively. In addition, Performance Expectancy also significantly correlates with Perceived Enjoyment (r = 0.606) and Social Influence (University, r = 0.447). Effort Expectancy correlates significantly with Perceived Enjoyment (r = 0.675) and Usage Intensity (r = 0.316), therefore supporting hypotheses H2c and H2a. In addition, Effort Expectancy also significantly correlates with Facilitating Conditions (r = 0.533). Finally, Facilitating Conditions correlates significantly with Perceived Enjoyment (r = 0.375). All other hypotheses related to Usage Intensity (H1a, Performance Expectancy; H3, Social Influence; H4a, Facilitating Conditions; H5, Perceived Enjoyment) are not supported by the data.

Table 5

Correlation Matrix

Constructs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. Performance Expectancy	-	-	-	-	-	-	-
2. Effort Expectancy	.443**	-	-	-	-	-	-
3. Facilitating Conditions	.269*	.533**	-	-	-	-	-
4. Perceived Enjoyment	.606**	.675**	.375**	-	-	-	-
5. Social Influence (Students)	-.048	-.094	-.037	-.055	-	-	-
6. Social Influence (University)	.447**	.216	.108	.234	.024	-	-
7. Usage Intensity	.016	.316*	.222	.193	.050	-.080	-

Note: *n* = 61, ** Correlation is significant at the 0.01 level (2-tailed),* Correlation is significant at the 0.05 level (2-tailed).

Next, we will look at the two moderating variables of this study, Gender and Prior Experience. When comparing male users with female users, we notice a substantial difference: male users have an average Usage Intensity score of 0.67 (*n* = 14, *SD* = 0.25), whereas female users have an average score of 0.49 (*n* = 13, *SD* = 0.19). After performing an Independent Samples T-Test, we can conclude that these differences are significant (*t* = 2.064, *df* = 25, *p* = 0.050). Table 6 presents the results of the moderator analyses. These results show that there is no evidence to support any the moderating hypotheses involving the Gender variable, therefore rejecting hypotheses 6a, 6b and 6c.

Next, we will compare the Usage Intensity between students who play video games on a regular basis (referred to as *gamers*) and those who do not (referred to as *non-gamers*). When we exclude the non-users, results show that the average Usage Intensity of the gamers is 0.65 (*n* = 15, *SD* = 0.22), whereas the average Usage Intensity of the non-gamers is 0.50 (n = 12, *SD* = 0.24). After performing an Independent Samples T-Test, these differences do not appear to be significant (*t* = -1.667, *df* = 25, *p* = 0.108). Looking again at Table 6, which displays the results of the moderator analyses, we furthermore conclude that there is no evidence to support hypothesis 7: Perceived Enjoyment will contribute to Usage Intensity more strongly for students who regularly play video games compared to students who do not.

Table 6.

Moderator Analyses with Usage Intensity as dependent variable

Construct	Moderator	*β*	*t*	*p*
Performance Expectancy	Gender	0.052	0.298	0.767
Effort Expectancy	Gender	-0.337	-1.615	0.112
Social Influence (Students)	Gender	0.267	1.538	0.130
Social Influence (University)	Gender	0.052	0.312	0.756
Perceived Enjoyment	Experience	0.302	1.540	0.129

When comparing the scores of the six constructs between the gamer and non-gamer group, we did find that gamers evaluated the Perceived Enjoyment construct significantly higher compared to non-gamers (t = 2.795, df = 59, p = 0.007). This seems to support the idea that gamification is favoured by those who already have some experience with video games in general. Although *not* significant, students who play video games also evaluated Performance Expectancy, Effort Expectancy and Facilitating Conditions higher compared to students who do not play video games on a regular basis.

An overview of the constructs measured in this study is presented in Table 7. Here we see that all constructs, with the exception of Social Influence (University), have a relatively high score. Performance Expectancy, Effort Expectancy, Facilitating Conditions and Perceived Enjoyment all scored above 0.64, therefore suggesting that InStaQuest was perceived as somewhat useful, easy to use and enjoyable, without any organizational or technical barriers to hinder its use. The slightly higher average of 0.72 for the construct Social Influence (Students) tells us that some social pressure from fellow students was present, however the same cannot be said for the Social Influence (University) construct, which has an average score of 0.48.

Table 7

Construct Comparison between Users and Non-users

Constructs	**Users**	**Non-users**	**Total**
Performance Expectancy	0.63 (*SD* = 0.19)	0.66 (*SD* = 0.13)	0.64 (*SD* = 0.16)
Effort Expectancy	0.70 (*SD* = 0.16)	0.63 (*SD* = 0.13)	0.66 (*SD* = 0.15)
Facilitating Conditions	0.74 (*SD* = 0.13)	0.69 (*SD* = 0.13)	0.71 (*SD* = 0.13)
Perceived Enjoyment	0.69 (*SD* = 0.18)	0.67 (*SD* = 0.12)	0.68 (*SD* = 0.15)
Social Influence (Students)	0.72 (*SD* = 0.16)	0.67 (*SD* = 0.16)	0.69 (*SD* = 0.16)
Social Influence (University)	0.45 (*SD* = 0.18)	0.49 (*SD* = 0.15)	0.48 (*SD* = 0.17)

Table 7 makes a distinction between users and non-users as well. What is interesting to note is the difference in Performance Expectancy; albeit the difference is small, non-users perceived the gamified e-learning application to be more useful compared to those who had actually used InStaQuest. One possible explanation for this is that the program did not fulfil its initial expectations. Independent Samples T-Tests were performed to see if significant differences existed between the users and non-users regarding the six constructs presented in Table 6. These tests did not result in any significant differences between the two groups.

Students who did not participate in InStaQuest were asked about their motives for non-adoption. The results are presented in Table 8. Noticeably, time played a major role in the adoption decisions of the non-users, as 46.9% stated that *insufficient time* influenced their decision to a great extent. Another important motive was *lack of interest or motivation*, which 56.3% of the non-users answered with *somewhat*, though this motive seemed not to have played a key role as only 3.1% stated that it influenced their decision to a great extent. *Lack of information* seemed to have hindered usage as well, since the answers *somewhat* and *to a great extent* combined account for 43.7% of the answer possibilities. Finally, we can conclude that the remaining motives (Dislike of technology, Dislike of method, Lack of skills or confidence, Privacy, and Technical) played little to no role in the adoption decisions of the non-users.

Table 8.

Motives for non-adoption

Motive	**Not at all**	**Very Little**	**Somewhat**	**To a great extent**
Lack of interest or motivation	9.4%	31.3%	56.3%	3.1%
Lack of information	15.6%	40.6%	28.1%	15.6%
Dislike of technology	56.3%	31.3%	6.3%	6.3%
Dislike of method	50.0%	28.1%	15.6%	6.3%
Lack of skills or confidence	50.0%	25.0%	18.8%	6.3%
Insufficient time	3.1%	28.1%	21.9%	46.9%
Privacy	62.5%	31.3%	6.3%	0.0%
Technical	65.6%	21.9%	12.5%	0.0%

DISCUSSION

Main Findings - This exploratory study aimed to investigate the roles of Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Perceived Enjoyment in explaining the Usage Intensity of a gamified e-learning application in a higher educational setting. Data have been gathered through the use of a gamified e-learning application that was designed and then implemented into a university statistics course. The results provided in the previous section indicate that the conceptual model of this study (see Figure 3) was not capable of explaining the adoption behaviour of students. Following the multiple linear regression analysis, a significant correlation was found between Effort Expectancy and Usage Intensity. This finding stresses the importance of the ease of use once more: a gamified e-learning application that is too difficult to use will be used to a lesser extent by its target users.

Consistent with previous information technology adoption literature, all hypotheses regarding the interrelationships of the independent variables were supported. In addition, two unexpected associations were found. First, Performance Expectancy showed a significant correlation with Perceived Enjoyment, therefore suggesting that as the perceived usefulness of a gamified e-learning application increases, the enjoyment derived from using the application increases as well. Second, Performance Expectancy showed a significant correlation with Social Influence (University). This finding seems to suggest that students are influenced by the opinion of those representing the university: when teachers openly favour the use of the gamified e-learning application, students are likely to perceive the application as more useful. Understandably, if teachers show a less favourable attitude towards the use of a gamified e-learning application, students will probably assume that the application will not benefit their study performance.

Finally, this study found a significant difference between male and female users regarding the Usage Intensity construct. After adoption had taken place, male students used the gamified e-learning application to a greater extent compared to female students. This finding seems to suggest that gamification methods are favoured by men, though future studies are needed to validate this assumption.

Recommendations for Future Studies – Given the exploratory nature of this study, we will proceed this discussion by reviewing our research design. The research question of this study reads: *Which factors explain the individual adoption of gamification in higher education?* Besides Effort Expectancy, none of the other constructs showed a significant association with Usage Intensity. What led to these results? One possible explanation for these findings would be a mismatch between the UTAUT model and gamification. In the theory section of this article, we argued that users are more likely to assess gamification applications based on their hedonic features. Given that Venkatesh et al. (2003) tested the UTAUT model with utilitarian systems in workplace environments, the model might be less successful in explaining the adoption of hedonic systems that are targeted for usage during leisure time. This is in line with van der Heijden (2004), who concluded that the validity of the Technology Acceptance Model (Davis, 1986) could be threatened when applied to hedonic systems. However, since the Perceived Enjoyment construct did not show a relationship with Usage Intensity, the solution of adding more hedonic features as independent variables seems to be unjustified. In fact, we still hold on to the idea that the UTAUT, *with the addition of the Perceived Enjoyment construct*, is capable of explaining the adoption of gamified e-learning applications. After all, the nature of gamified technologies is not purely hedonic nor is it utilitarian: it is a combination.

Another feature on which this study deviated from the original UTAUT model is the conceptualization of the dependent variable. In the UTAUT model, Venkatesh et al. (2003) measure usage as the "*duration of use via system logs*" (p. 438). Although this might give an indication of the level of involvement users have with a system, we believe it does not cover all aspects of usage behaviour. In this current study, Usage Intensity was constructed using three metrics: the amount of logins (which can be seen as similar to the way usage was measured in the study by Venkatesh et al.), the amount of activities performed, and the depth of use. The addition of the latter two variables has provided us with a better understanding of usage behaviour. To illustrate, without the depth of use metric, we would have not been capable of distinguishing students active in the play environment from students who were merely using practice environment functionalities. Hence, we recommend future studies to measure usage behaviour in a similar approach.

Continuing our review of the dependent variable, something we thought was missing in our conceptual model was the *Attitude* construct. This variable is often used as a predictor for the *Intention to Use* (as is the case in the Technology Acceptance Model – see figure 1). However, as we did not plan on measuring intentions but rather the actual usage of the students, we decided to exclude the Attitude – Intention link from our conceptual model and replace it by a single dependent variable: Usage Intensity. In hindsight, the Attitude construct would have been a suitable variable to make comparisons between the users and non-users of this study. The reason for this is that the Usage Intensity construct gives the same value to all non-users: *zero*. When the degree of user participation is low, as was the case in this current study, the Usage Intensity construct will hold many zero values, which may even lead to a skewed data distribution. Hence, we advise future studies to include the Attitude construct into their research models (e.g. as a predictor of Usage Intensity), as this is likely to give additional valuable insight into the adoption motives of target users.

Next, an important finding that is relevant for future research is the contradiction found within the Social Influence construct. The original Social Influence item scale by Venkatesh et al. (2003) does not make a distinction between social groups. However, one can imagine that different social groups exist that influence the behaviour of individuals. In the context of this study, both teachers and fellow students are likely to influence the behaviour of individuals regarding the use of the gamified e-learning application, yet the intent of these influences do not need to be similar. This led to the decision to divide the Social Influence construct into two distinct constructs: one that measured the influence of university representatives, and one that measured the influence of fellow students. Evidently, this is not an idealistic approach as we were forced to divide four items across two constructs, therefore threatening the validity of the measurement. As a consequence, we recommend future studies to make this distinction beforehand, using similar item scales to measure the two social groups separately.

In addition to the conceptual model used in this study, one might also argue that the gamified e-learning application itself had influenced the results. After all, the analyses performed in previous section are based upon the perceptions students have of InStaQuest. Would the results have been different if the gamified application had been designed in a different way? Most likely, but this should not influence the regression model itself. To demonstrate: when a technology that is being studied is badly designed, the Effort Expectancy construct should be able to explain the low levels of usage. Likewise, if a gamified e-learning application is not entertaining, the Perceived Enjoyment construct should be capable of explaining these findings. For that reason, we believe that the conceptual model used in this study should be capable of explaining usage behaviour for both well and poorly designed applications.

Nevertheless, what *is* directly influenced by the quality of design is the degree of user participation. Understandably, (e-learning) applications which are poorly designed will be used less by potential users. Given that out of the 114 students who formed the target group of InStaQuest, only 27 had actually adopted the application, we have to ask ourselves: *was InStaQuest poorly designed*? If we look at the average scores on Performance Expectancy, Effort Expectancy and Perceived Enjoyment (see Table 7: *Construct Comparison between Users and Non-users*), we find that InStaQuest was perceived as somewhat useful, easy to use and enjoyable. Although there is room for improvement, we believe that the design of the application was not the main cause for the low degree of participation.

One different, fundamental explanation, would be that university students are simply not interested in learning methods that include game design elements. Results from our online survey show some support for this claim, with 56.3% of the non-users stating that a *lack of interest or motivation* was *somewhat* important in their decision to not use InStaQuest (see Table 8: *Motives for non-adoption*). Contrariwise, *dislike of technology* and *dislike of method* did not appear to be important motives for non-users. Hence, we cannot provide a definitive answer for this matter. What we can clearly conclude from Table 8, is that *insufficient time* played an important role. It appeared that students were too busy with other (study) tasks, which one might expect of a university student. This also explains why the practice environment was favoured over the play environment. Where the former only contained familiar game elements that required no further explanation, the latter was built around a storyline, incorporating a lot of text and images. Given the busy lifestyle of students, it is reasonable to assume that they did not feel like reading the introduction and instruction texts which were found in the play environment. In addition, these texts might have even scared some of the students off, as some student responses seem to suggest (see Appendix C). Hence, these findings suggest that gamification targeted at higher educational students should focus on fast-paced and easy-to-use game mechanisms. While storylines are considered to be an important aspect of gamification, we believe that these contribute less in higher educational settings. Moreover, writing narratives can take up a lot of time, which in hindsight, could be better invested in creating other practice functionalities.

Lastly, we would recommend future studies to control the added value of gamification. This can be done by conducting experiments that include control groups. To illustrate, one could have easily stripped off the game elements from the practice functionalities in this study, leaving only the multiple choice questions without the points, levels and leaderboards. By making a comparison between the two types of applications, one can acquire a better understanding of the added value that gamification has on learning engagement.

Limitations and Future Research

This study had several limitations that should be taken in account. First and foremost, the gamified e-learning application was not picked up by many students. This limitation was a rather crucial one, as it led to several further limitations. First, the low amount of participants made it necessary to adjust our measurement tool. Instead of using the gamified e-learning application to measure the constructs of this study, an online survey had to be created that could measure the perceptions of the non-users as well. In return, this method had its own limitations, as non-users only received a description of the website (including screenshots). Evidently, we can assume that students who have actually worked with InStaQuest were better capable of evaluating the application compared to students who merely received a description. In addition, many non-users turned out to be rather positive about InStaQuest, therefore disrupting our hypotheses that non-users would evaluate the gamified e-learning application less favourable compared to actual users. Consequently, this influenced the results of the multiple regression analysis.

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APPENDIX A: ITEM SCALES

A.1. Performance Expectancy

- Using InStaQuest improved my study performance
- The use of InStaQuest did not have any effect on my grade for this course
- InStaQuest enabled me to learn statistics more quickly
- InStaQuest was a useful tool for learning statistics

A.2. Effort Expectancy

- InStaQuest was difficult to use
- I was skilful at using InStaQuest
- Operating InStaQuest was easy
- My interaction with InStaQuest was clear and understandable

A.3. Social Influence

- In general, my university supported the use of InStaQuest
- People who I appreciate thought that I should have used InStaQuest
- My fellow students thought using InStaQuest was a bad idea
- My teachers encouraged me to use InStaQuest

A.4. Facilitating Conditions

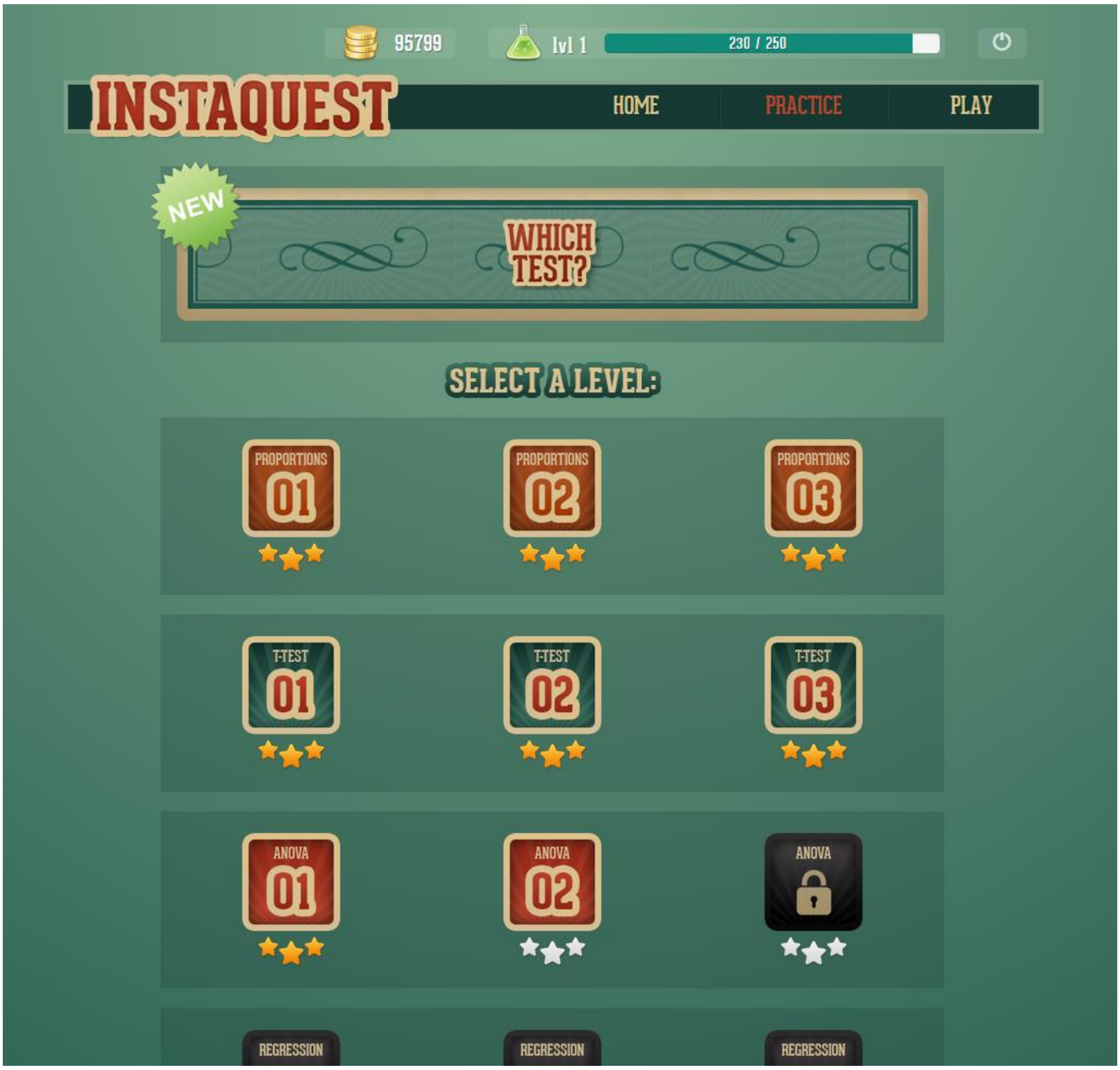
- I had the resources necessary to use InStaQuest
- I did not have the knowledge necessary to use InStaQuest
- InStaQuest was not compatible with the devices I used
- If I (would have) encountered difficulties with InStaQuest, someone was available for assistance

A.5. Perceived Enjoyment

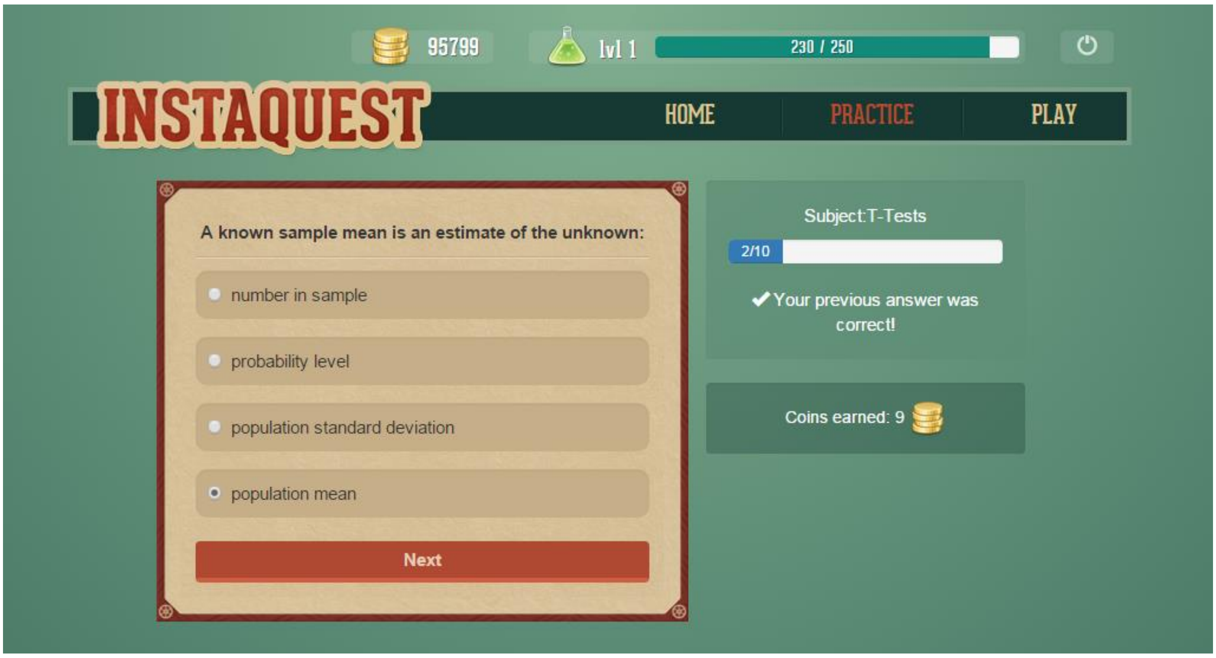
- I experienced fun when I was using InStaQuest
- I found InStaQuest to be dull/boring
- It was exciting to use InStaQuest
- The actual use of InStaQuest was enjoyable

APPENDIX B: INSTAQUEST SCREENSHOTS

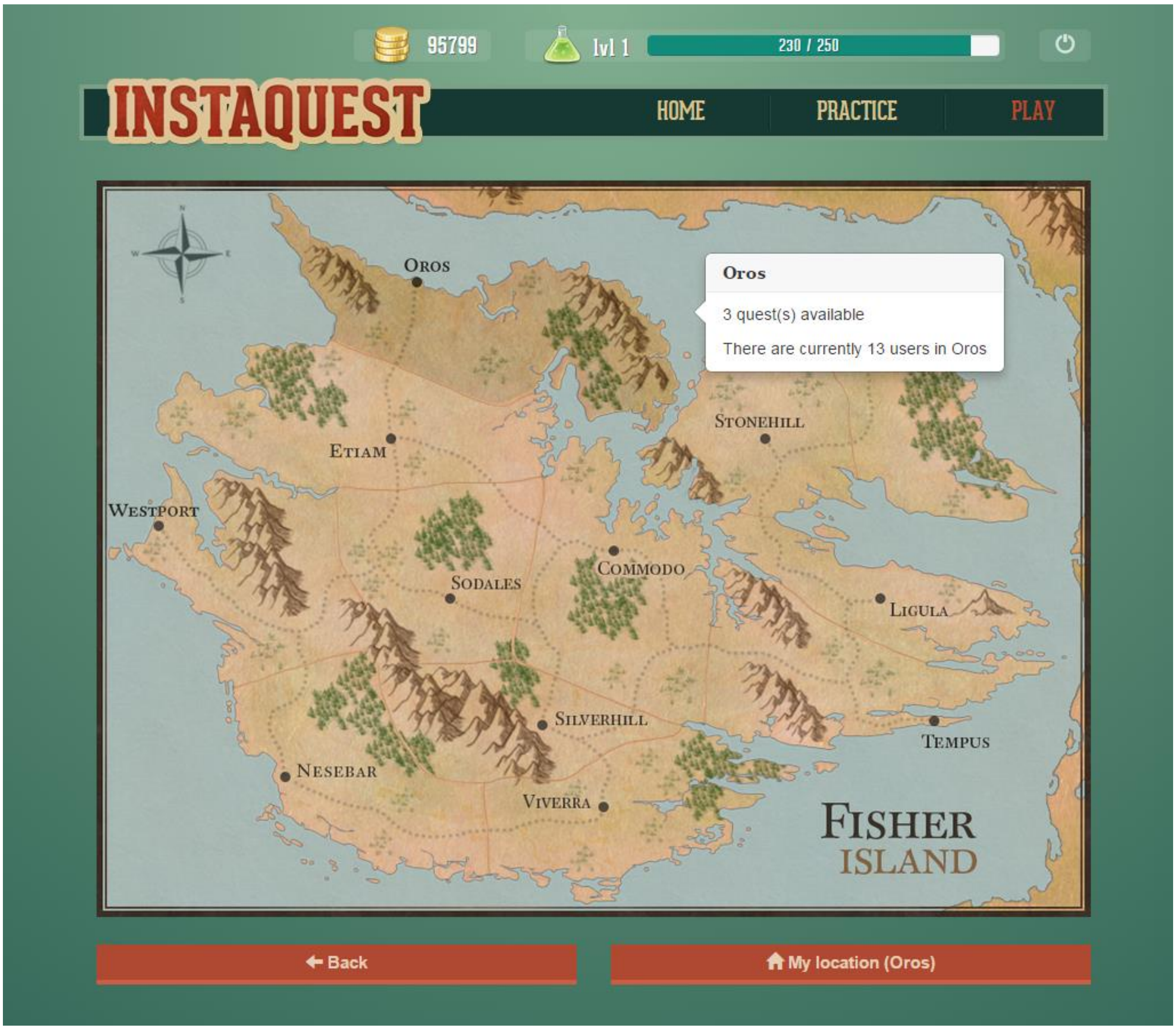
B.1. Level Overview of the Practice Environment



B.2. Multiple Choice Level in the Practice Environment



B.3. *Fisher Island* as displayed in the Play Environment



APPENDIX C: STUDENT RESPONSES

If it could be used a bit easier and has a bit more interactive features and help, it would have been better.

--

There was too much text, while in reality, this is not the case.

--

I would have liked the possibility to start solving example formulas immediately... It takes forever to get through the theory

--

You couldn't view the right answer whenever a question was answered incorrectly. This way you could just keep guessing until you found the right answer. I found the multiple choice questions more useful compared to the tool in which you had to match a given problem with an appropriate test.

--

In the 'which test to use' exercise the correct answer was not given. I didn't understand quickly were to start with the quests so I did not do this. It took too long to figure out.

--

It sure looks like it could have been helpful and actually fun too, but with limited time I wanted to stick to what I was sure of would be in the test. Perhaps you could offer InStaQuest as an (optional) course for students who are thinking about transferring to the University. I think it could be a relatively easy and fun way to get introduced to statistics on a high educational level.

--

The experience was enjoyable and a learning journey.

I could only see which questions I had wrong, not the correct answers for these questions. I would have liked it more if I could just see the correct answers afterwards.

--

During the tutorials it was said that making the exercises was sufficient to pass the exam.

--

The overview was not very clear. The steps to take were not very clear. Way too much text. I would consider less text and more obvious way to show what you need to do next.

--

Maybe if the tool was introduced earlier, and in the lectures, I would have tried it.