Facilitating intrinsic motivation in tertiary education through gameful design

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Declaration

I declare that the Master's dissertation, which I hereby submit for the degree MIS (Multimedia) at the University of Pretoria, is my own work and has not been previously submitted by me for a degree at another university.

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Abstract

Modern education systems tend to focus on the use of external pressures to motivate students to learn. Intrinsic motivation - motivation to do something because it is enjoyable in and of itself – by contrast, is more valuable in these environments as it has multiple benefits, such as better conceptual understanding and more sustained learning behaviour. The primary way to facilitate intrinsic motivation is to meet the three basic psychological needs of autonomy, competence and relatedness. Games are inherently effective at satisfying these needs and have in recent years begun to be used in non-game contexts, like education, in order to attempt to improve motivation. This is commonly known as gamification, although gameful design is the more beneficial counterpart thereof since it is directly based on a deep understanding of what makes games good motivators.

This study addresses the question of how gameful design can be used to facilitate intrinsic motivation in a tertiary education setting. This is done through an examination of existing literature in order to inform the design of a gameful intervention, which is the focus of this research. This intervention includes a new website, additional exercises on course content as well as changes to lectures. The intervention (in the form of a pilot study and a final implementation) is used in a first year undergraduate module in the Multimedia degree at the University of Pretoria.

When the intervention has been used by the students for a full semester, data are collected in the form of questionnaires, focus groups, Google Analytics, website database logs and observation. The results indicate that the gameful intervention meets the three basic psychological needs of those students who interacted with it. As a result of this, students are more intrinsically motivated to interact with the intervention and therefore spend more time engaging with the course content.

This study contributes a list of guidelines for educators wishing to use gameful design in their own modules. It also provides the details of the design of the intervention in order to aid the understanding of how gameful design can be used to facilitate intrinsic motivation. This approach to "gamifying" education is rare in the existing literature and can therefore be considered a valuable contribution.

Keywords

Gameful design, gamification, game studies, motivation, intrinsic motivation, self-determination theory, tertiary education, case studies

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1. Chapter 1 – Introduction

Games are incredibly powerful motivators that are able to keep players engrossed for hours at a time (Rigby & Ryan 2011:7–8). The growth of the computer game industry has led to an increased interest in the concept of gamification (Robson et al. 2015:412) in an attempt to harness this power of games and apply it to other contexts.

Gamification is a relatively young concept, having been coined in 2008 (Paharia 2012) and it has only seen widespread use since the second half of 2010 (Deterding et al. 2011). Unfortunately, the field is primarily filled with shallow implementations as the current interpretation of gamification does not show a deeper understanding of the psychology of games (Deterding 2014:306; Songer & Miyata 2014:206).

Gamification has specifically become popular in educational contexts (Hamari, Koivisto & Sarsa 2014:3029; Seaborn & Fels 2015:27) as educators try to find ways to motivate students to learn.

This study is focused on the psychology of games in order to gain a deeper understanding of how they are able to motivate people. In addition to being good motivators, games also contain components that make them effective in education (Gee 2003:72). By examining how games facilitate motivation and learning, and then applying these concepts to the non-game context of tertiary education, it is possible to enhance the intrinsic motivation of the students.

1.1 Background to the study

The concept of motivation is concerned with a person's reason for doing an activity (Deci & Ryan 1985a:3; Reeve 2009:8). Self-determination theory (SDT) is a well-established (Deterding 2015:298) theory of motivation that deals with the conditions which enable or hinder human development (Ryan & Deci 2017:3). Self-determination theory focuses on two different types of motivation – intrinsic and extrinsic (Deci & Ryan 2008:182; Ryan & Deci 2017:14) - as well as on three basic psychological needs (Deci & Ryan 2008:183). Intrinsic motivation, the focus of this study, is the type of motivation which causes a person to do an activity for the inherent pleasure it provides and not for any external reason (Deci & Ryan 1985a:34; Ryan & Deci 2000a:56; Reeve 2009:111). SDT posits that intrinsic motivation is inherent in humans and can be fostered under the correct conditions (Ryan & Deci 2000b:70); specifically conditions that satisfy the three basic psychological needs (Ryan & Deci 2000b:68).

The three basic needs are competence, autonomy and relatedness. Competence refers to a person's desire to be effective in their interactions within an environment (Deci & Ryan 1985a:27; Deci & Ryan 2002:7; Reeve 2009:155). Autonomy is the need for a person to be directed by their own choices (Reeve 2009:145). Finally, relatedness is the need for belonging within a community and to feel connected to others (Deci & Ryan 2002:7).

Games are able to motivate people to play for long periods of time without any external motivation (Rigby & Ryan 2011:7–8). This is because they are inherently intrinsically motivating and able to satisfy the three needs (Rigby & Ryan 2011:10). As a result, there has been an attempt to use the power of games in other contexts such as marketing, exercise, habit formation and education in order to motivate users in these areas. This process became known as gamification. It is defined as "the use of game design elements in non-game contexts" (Deterding et al. 2011:10).

The concept of gamification has led to systems which commonly apply elements such as points, badges and leaderboards (Hamari, Koivisto & Sarsa 2014:3027) to a situation in an attempt to elicit the same motivating experiences as fully-fledged games. This shows a misunderstanding about what makes games fun (Songer & Miyata 2014:206) and is the reason why gamification implementations have been criticised for being "gamification without games" (Bogost 2015:68, 72). These criticisms can be summarised as a lack of understanding of game psychology and how games effectively meet the three needs (Deterding 2014:306).

Gameful design is the more beneficial counterpart to gamification (Deterding 2014:313). It is concerned with "affording *ludic* qualities or gamefulness in nongame contexts" (Deterding 2015:297). Both gameful design and gamification describe the same phenomenon, but they do so in different ways. Gamification is the design strategy of using game elements while gameful design is the goal of making a system more game-like (Deterding et al. 2011:11). In order to develop a system which is truly game-like, it is important to understand that the motivational experiences of games emerge from iterative testing, not from an additive approach as exhibited by many gamification implementations (Deterding 2015:300). It is therefore more beneficial to apply the principles of gameful design when attempting to meet the three needs and facilitate intrinsic motivation.

Intrinsic motivation is desirable in an education context because it has many benefits, including greater conceptual understanding (Benware & Deci 1984:763) and increased flexibility in the use of knowledge (Deci et al. 1991:326; Reeve 2009:113). These two properties are the defining

characteristics of optimal learning (Deci et al. 1991:326). An additional benefit of intrinsic motivation is that the behaviour is more likely to be sustained for a longer period of time (Reeve 2009:112). Unfortunately, modern education systems tend to focus on the use of grades and other external pressures to motivate students to learn. Instead of fostering intrinsic motivation, this leads to controlled environments which do not meet the three needs properly (Ryan & Deci 2017:353).

Gamification has been used in many educational settings (Hamari, Koivisto & Sarsa 2014:3028; Seaborn & Fels 2015:27) to improve student performance and motivation (Glover 2013:1999; Dichev et al. 2014:80; Van Roy & Zaman 2017:18). The current implementations are primarily focused on the concept of gamification as opposed to gameful design, and as such, lack depth and a focus on satisfying the three basic needs.

1.2 Problem statement

The overview above leads to the following problem statement:

- Intrinsic motivation is important in education, but it is difficult to achieve.
- Gamification has been used as a potential solution, but current implementations lack a focus on the psychology of game motivation.

1.3 Purpose of the study

Due to the difficulties of intrinsically motivating students in tertiary education contexts, this study focuses on using gameful design as a solution to this problem. The purpose of this study is to design and implement a gameful design system in a tertiary education context in order to improve the intrinsic motivation of the students. The study approaches the concept of gameful design from the perspective of game studies and motivation. With this theoretical framework established, it applies these principles to the design of a website which is implemented in an undergraduate university module.

1.4 Significance of the study

Most existing educational systems in this field focus on gamification as opposed to gameful design (section 0). By basing the design of the system on motivation and game design principles and successfully meeting the three basic psychological needs of the students, this study contributes helpful educational gameful design advice to the existing body of literature. This will

enable other educators to better design their own gameful systems in order to facilitate intrinsic motivation towards course content.

1.5 Research questions

The purpose of this study was achieved by answering the following primary research question. The sub-questions each addressed an aspect of the primary question and were answered from different sources within the study. This is shown in Table 1.

1.5.1 Primary research question

How can gameful design be used to facilitate intrinsic motivation in tertiary education?

1.5.2 Sub-questions

Question	Description	Source
Why is intrinsic motivation important in education?	Establishing the importance of intrinsic motivation in education is necessary as it is one of the reasons for conducting the study.	Literature
How can intrinsic motivation be facilitated?	In order to use gameful design to facilitate intrinsic motivation, it is important to establish the ways in which this can be done. This will inform the design of the gameful system.	Literature
Why is gameful design able to facilitate intrinsic motivation?	An understanding of how gameful design facilitates intrinsic motivation is both important for the design of the system as well as to answer the primary question. The empirical study will validate the concepts implemented in the system.	Literature and empirical

Question	Description	Source
How can an educational gameful system be designed to facilitate intrinsic motivation?	The educational gameful system will need to be designed to meet the requirements for intrinsic motivation. This will need to be validated through empirical testing. The manner in which the system is designed will provide evidence for answering the primary question.	Empirical

Table 1 - The sub-research questions of this study and the sources from which they will be answered

1.6 Research design

The empirical component of this study followed an interpretivist research paradigm as it was concerned with studying the social phenomenon of gameful design within the natural setting of education (Pickard 2013:11). This research paradigm implied a qualitative research methodology (Pickard 2013:13). The research method chosen was a case study because it is an applicable method to use if one wishes to gain an in-depth understanding of a phenomenon within its real-world context (Yin 2013:16).

An embedded single-case design was used as the gameful website designed was implemented in a single university module over a set period of time. Sources of evidence for the case study were archival records, interviews and direct observation. Further details of the case study design are provided in chapter 3.

1.7 Limitations and scope

This section outlines the limitations inherent in this study and then examines the scope of the study.

1.7.1 Limitations

The gameful website was designed to allow users to interact with course content in which there is little subjectivity as the module in which the final website was implemented taught basic website

design through HTML and CSS. The pilot study (discussed in section 4.2) results showed that the pilot website was not well-suited to course content which required creativity from the students.

As a result of this, not all the findings of the study can be directly transferred into another teaching domain; however, the design of the website provided helpful guidelines for the design of any other gameful teaching system and these guidelines are transferrable.

1.7.2 Scope

This study focused on the implementation of the gameful website within a single university module over the course of one semester. This scope excludes the pilot study in which the website was also implemented in a single module over one semester.

1.8 Summary of chapters

This chapter has provided an overview of the study including a background to the study, the purpose and significance of the study, the research questions and the research design.

The following chapters are used to guide the study in order to answer the research questions presented above. Chapter 2 provides a review of the literature in the field. Chapter 3 details the methodology followed in this study. Chapter 4 describes the design of the gameful system, based on what was established in the literature review. Chapter 5 provides an analysis of the data collected from the study. Finally, chapter 6 concludes the study by answering each of the research questions and providing suggestions for future research.

2. Chapter 2 – Literature Review

Chapter 1 introduced the study by discussing its background, research questions and research design. This chapter reviews the literature relevant to the study.

This literature review will cover four distinct concepts – motivation, games, gamification and gameful design and education. The focus of this dissertation is the use of gameful design to improve motivation in an educational setting. For this reason, each of the aforementioned concepts must be addressed so as to demonstrate how gameful design is able to achieve this goal.

2.1 Motivation

This section discusses motivation, focusing specifically on self-determination theory as it is the guiding theory for this study. Since games are able to motivate people to play for long periods of time, the question becomes how it is possible to use that motivational power in other contexts (Rigby 2015:114). For this reason, an understanding of motivation is needed in order to understand the motivational power of games and then apply it to an area such as education.

The study of motivation is concerned with "the processes that give behaviour its energy and direction" (Deci & Ryan 1985a:3; Reeve 2009:8). This means that a motivational theory is concerned with both the level of motivation (energy) as well as the orientation (direction) (Ryan & Deci 2000a:54). Ryan and Deci (2000a:54) argue that some motivational theories are only focused on the amount of motivation that a person has, but what is also important to consider is their underlying goals and attitudes for performing a behaviour.

2.1.1 Self-determination theory

Self-determination theory (SDT) is a well-established theory in human psychology (Vallerand, Pelletier & Koestner 2008:257; Vansteenkiste, Niemiec & Soenens 2010:105; Deterding 2015:298) that explains human motivation. It was developed by Richard Ryan and Edward Deci in the 1980s. It is not the only theory of human motivation, but this theory is specifically relevant to the current study because of its emphasis on the different types of motivation (Deci & Ryan 2008:182; Ryan & Deci 2017:14) as well as on the three psychological needs (Deci & Ryan 2008:183). SDT has empirical support in contexts such as education (Deci et al. 1991; Deci, Koestner & Ryan 2001; Reeve & Jang 2006; Niemiec & Ryan 2009) and games (Ryan, Rigby & Przybylski 2006; Przybylski, Rigby & Ryan 2010), among others (Deci, Connell & Ryan 1989; Grolnick & Ryan 1989; Williams et al. 1996; Williams, Freedman & Deci 1998; Gagné & Deci

2005; Vansteenkiste et al. 2007; La Guardia & Patrick 2008; Ryan, Huta & Deci 2008; Ryan et al. 2009; Teixeira et al. 2012; Deci & Ryan 2014).

SDT approaches human motivation from an organismic and dialectic point of view (Deci & Ryan 2002:8). It is organismic in that that it regards humans as active participants in their own motivation, able to make their own decisions and initiate their own behaviour (Ryan & Deci 2017:4–5). From this perspective, humans have innate needs that give them a reason to act on the environment around them, rather than simply reacting to it as is the view of mechanistic theories (Reeve 2009:143). The environment provides the opportunity for the individual to satisfy their needs; it is not the cause of their behaviour (Deci & Ryan 1985a:3–4; Reeve 2009:143). The dialectic nature of SDT means that there is a two-way relationship between the person and their environment. Each acts on the other and both are constantly changing (Reeve 2009:144). This is an important aspect of the theory because it means that the environment has the potential to aid or hinder an individual in meeting their needs (Deci & Ryan 2002:6).

One of the components of organismic motivational theories, as well as the basis of SDT, is intrinsic motivation (Deci & Ryan 1985a:35). When a person does an activity without being controlled or receiving a reward, it is assumed that they have intrinsic motivation for that activity. The activity is done for the inherent satisfaction that it provides; it is done simply because it is interesting and enjoyable (Lepper, Greene & Nisbett 1973:129; Deci & Ryan 1985a:34; Ryan & Deci 2000a:56; Reeve 2009:111). SDT was developed when the study of intrinsic motivation led to the realisation that self-determination is important in the development of both intrinsic and extrinsic motivation (Deci & Ryan 1985a:35). Self-determination is defined as the capacity to choose, not only to choose, but for an individual's choice to be the determinant for their action. This means that rewards or external pressure should not affect the choice (Deci & Ryan 1985a:38). From birth, people manifest tendencies toward intrinsic motivation, and the ability to incorporate external events within their sense of self through a process called internalisation and integration (discussed in section 2.1.1.2.2) (Ryan & Deci 2017). In order for this process to continue as the person grows up, SDT posits that there are three basic psychological needs which must be satisfied (Ryan & Deci 2000b:68).

The following two sections will discuss the three needs as well as the relevant mini-theories that make-up SDT.

2.1.1.1 Basic psychological needs

A need is an internal condition of an individual that is essential for life, growth and well-being (Reeve 2009:77). SDT is concerned with psychological needs (Reeve 2009:78). SDT asserts that the fulfilment of these needs leads growth and well-being (Deci & Ryan 2002:7; Pittman & Zeigler 2007:481; Ryan & Deci 2017:82). The three psychological needs are autonomy, competence and relatedness.

2.1.1.1.1 Autonomy

The term autonomy means "self-governing" (Ryan & Deci 2017). It is a desire of a person to have their behaviour directed by their own preferences (Reeve 2009:145); to have freedom of choice. It involves being able to choose which goals to pursue and to control the pursuit (Deci & Ryan 1985a:154). There are three concepts which aid the understanding of autonomy – perceived locus of causality, volition and perceived choice (Reeve 2009:146).

Perceived locus of causality (PLOC) was first defined by Heider (1958) and later expanded-upon by de Charms (1968). It focuses on a person's reason for performing an action. An internal perceived locus of causality assumes that when a person acts, their own interests and desires initiate the action. When an external event is the initiator of the action, then the person is considered to be acting out of an external perceived locus of causality (Deci & Ryan 1985a:7). This is relevant to autonomy because it has been found that the extent to which factors outside of the self are the cause of an activity is the degree to which the activity is experienced as non-autonomous (Ryan & Connell 1989:759). This is important because it shows that the context in which an action occurs plays a role in the motivation of that action; this is called functional significance (Deci & Ryan 2002:63). An environmental or social factor can have a functional significance of being either autonomy-supportive or autonomy-controlling (Deci & Ryan 1987:1025; Pelletier et al. 2001:283).

The second concept related to autonomy is volition. It is defined as "a sense of unpressured willingness to engage in the action" (Deci, Ryan & Williams 1996:165) or "the capacity for voluntary action" (Haggard 2008:934). A person's volition is high when they engage in an activity and feel that it was their free choice to do so (Reeve 2009:146). An activity which is autonomy controlling would result in the opposite of volition – where a person is pressured into performing an action.

Lastly, perceived choice also affects autonomy (Reeve 2009:147). Environments that provide decision-making flexibility will be more autonomy supportive (Zuckerman et al. 1978). This

shows that while autonomy is an internal state, it can be affected by social environments (Ryan et al. 2009:115)

2.1.1.1.2 Competence

Competence concerns a person's interactions with the environment and the desire to be effective in those interactions (Deci & Ryan 1985a:27; Deci & Ryan 2002:7; Reeve 2009:155). Competence creates a need for people to exercise their abilities and look for challenges that are optimal for their abilities. Competence is gained from interacting with situations that are challenging to an individual (Deci & Ryan 1985a:28). This relates to flow theory which will be discussed in section 2.1.2 (Reeve 2009:155; Rigby 2015:120). Importantly, competence does not refer to skills gained, but to the feelings of confidence and satisfaction (Deci & Ryan 2002:7).

Competence can be fostered by giving feedback when a person makes progress and by providing opportunities for them to engage in optimal challenges (Reeve 2009:160). A person's skills are not the only factor that affects competence; the social environment around them - such as teachers, coaches or significant others - also have the ability to provide feedback and thus affect competence in a negative or positive way (Ryan et al. 2009:114).

2.1.1.1.3 Relatedness

Relatedness is feeling of belonging and acceptance within in a community; a sense of being connected to others (Deci & Ryan 2002:7). The desire of a person to feel accepted by others is not in order to obtain some external outcome, but because it provides a sense of unity and security (Deci & Ryan 2002:7). Rigby (2015:121) describes relatedness as the need "to feel that 'I matter' to others and that they matter to me". This need goes both ways and thus it is satisfied when a person is cared for by others as well as when they have the opportunity to care for others (Ryan & Deci 2017:86).

Rigby and Ryan (2011:68) describe three elements that are important in satisfying relatedness. Firstly, acknowledgement – being noticed and feeling like one has someone's full attention. Secondly, support is the desire to have the person understand one and help to facilitate satisfaction of autonomy and competence. Finally, impact refers to a desire for one to see their impact on another person.

2.1.1.2 The six mini-theories of self-determination theory

SDT is divided into six mini-theories, each addressing a different aspect of the theory. These theories are described in the following sections in different degrees of detail depending on their relevance to this study.

2.1.1.2.1 Cognitive evaluation theory (CET)

This was the first mini-theory that was developed in order to identify social and environmental factors which affect intrinsic motivation (Ryan & Deci 2000b:70; Deci & Ryan 2002:9; Vallerand, Pelletier & Koestner 2008:107). CET is based on the assumption that intrinsic motivation is inherent in humans and will be fostered if the conditions are correct (Ryan & Deci 2000b:70). It is important to note that not all people are intrinsically motivated towards all activities. The principles of CET will only apply to activities which hold intrinsic interest for the individual (Ryan & Deci 2000b:71). The second mini-theory, organismic integration theory, deals with activities which are not intrinsically interesting to the individual (section 2.1.1.2.2).

CET relies primarily on the needs of competence and autonomy, specifying that competence alone will not enhance intrinsic motivation; it must be accompanied by autonomy. This means that to be intrinsically motivated, a person must not only feel competent towards a task, but they must also be acting out of an internal perceived locus of causality (Ryan & Deci 2000b:70).

CET presents five propositions in order to describe the effect of external events on motivation. The first three describe the general effects of external events, proposition 4 focuses on the effects of interpersonal contexts and proposition 5 deals with intrapersonal contexts. Since proposition 5 is concerned with various self-esteem-related pressures, it is not relevant to the current discussion of motivation pertaining to gameful design. Propositions 1 to 4 are discussed in the following sections.

2.1.1.2.1.1 Propositions 1, 2, 3 and the effects of rewards

These three propositions should be discussed together in order to understand fully the effects of external events on intrinsic motivation. The concepts of perceived locus of causality and functional significance (section 2.1.1.1.1) are critical to this discussion. Proposition 1 deals with effects on autonomy, proposition 2 focuses on effects on competence and proposition 3 describes the three aspects of external events and their influence in intrinsic motivation in general.

Proposition 1 (Deci & Ryan 1985a:62; Ryan & Deci 2017:129) is concerned with the effect of external events on a person's autonomy and therefore their intrinsic motivation. Specifically, it states that intrinsic motivation will be affected depending on how the PLOC is affected. If the

events lead to an external PLOC then they will undermine intrinsic motivation because they damage self-determination. This is because they cause a person to act for a reason beyond their own will or desires, which makes the act less self-determined. These types of events are considered controlling. Events that lead to an internal PLOC will enhance intrinsic motivation and are considered to support autonomy. Proposition 1 can be summarised in the following question, "Is the purpose of the extrinsic event to control another person's behaviour?" If the answer to this question is no, then autonomy and intrinsic motivation will not be undermined (Reeve 2009:128).

Proposition 2 (Deci & Ryan 1985a:63; Ryan & Deci 2017:130) describes how external events are able to affect a person's competence. Here it should be reiterated what was stated in the previous section: both competence and autonomy are necessary in order to facilitate intrinsic motivation. External events can impact competence in a positive sense if the feedback provided by the event is positive or in a negative sense if the activity is too difficult, the person is continually failing or if negative feedback such as discouragement is provided (Deci & Ryan 1985a:63; Reeve 2009:129).

Lastly, proposition 3 (Ryan & Deci 2017:130) provides additional context for the previous two propositions by describing the three aspects of external events and how these aspects can affect intrinsic motivation. Specifically, the proposition states that external events which can affect the initiation and regulation of behaviour have three aspects – informational, controlling and amotivating. The relative salience or prominence of each of these aspects determines how the event is experienced by the individual as it determines the functional significance (section 2.1.1.1.1.) of the event. Informational events allow choice and provide a person with information that is helpful in their attempts to complete an activity (Deci & Ryan 1985a:96). These events have a positive effect on competence and autonomy and therefore on intrinsic motivation. Controlling events place pressure on a person to think, feel or behave in certain ways (Deci & Ryan 1985a:95). They negatively affect autonomy, thereby decreasing intrinsic motivation (Reeve 2009:129). Amotivation occurs when environments do not allow autonomy or competence for a behaviour. This could lead to feelings of helplessness or depression. It tends to occur when one perceives oneself to be incompetent towards a particular goal. The cause of this is persistently negative feedback or repeated failure (Deci & Ryan 1985a:71).

The extensive reference to external events in this section necessitates a discussion of rewards because they are a general category of external events which can affect intrinsic motivation. CET has its roots in research that aimed to determine the effects of extrinsic rewards on intrinsic motivation (Deci 1971). Four different categories of rewards were identified.

The first is task-noncontingent rewards. These are rewards given to people for participating in an experiment, regardless of what they do in the experiment. These types of rewards appear to have no adverse effect on intrinsic motivation because they are not experienced as controlling (Deci & Ryan 1985a:73, 75). Unexpected rewards also fall into this category because the person is not aware of them until they are given (Ryan & Deci 2017:138).

Task-contingent rewards are given for performing a task or experiment, for example, giving a person $1 per puzzle that they complete in a study. Numerous studies have shown that these types of rewards have a negative effect on intrinsic motivation because they are viewed as controlling (Ryan, Mims & Koestner 1983:748; Deci & Ryan 1985a:75–76; Deci, Koestner & Ryan 2001:11). The task must first be done in order to get the reward, which makes the reward more controlling than a task-noncontingent reward.

The third type of reward is performance-contingent rewards. It is given for a specified level of effective performance. This type of reward could be experienced with either the controlling or informational aspect being salient. The reason for this is the fact that these types of rewards provide competence feedback by default which could have a positive or negative effect depending on what the feedback is (Deci & Ryan 1985a:78–80). For example, if the reward conveys that the person has done well at a task, then the feedback could bolster competence. However, if the feedback causes the person to feel pressured to meet some external standard in order to receive the reward, then the feedback is considered controlling (Ryan & Deci 2017:133). Neural studies have shown that performance-based rewards harm intrinsic motivation (Murayama et al. 2010:5).

The final type of reward is competitively-contingent rewards. In this situation, people are required to compete directly with each other for a limited number of rewards. These rewards are experienced as controlling because winning is instrumental in receiving the reward (Deci & Ryan 1985a:80).

In summary, verbal rewards are found to improve intrinsic motivation while tangible rewards undermine it (Ryan & Deci 2017:140). Competitively-contingent rewards are viewed as the most controlling and therefore the most undermining of intrinsic motivation. This is followed by performance contingent and then task contingent rewards. Task-noncontingent rewards are viewed as the least controlling. Any reward that involves positive performance feedback tends to enhance intrinsic motivation because it is viewed as informational and increases feelings of

competence, but all contingent rewards have a negative effect on intrinsic motivation despite any positive feedback due to their controlling nature (Deci & Ryan 1985a:81).

In addition to tangible rewards, it has also been found that threats, deadlines, evaluations and imposed goals also diminish intrinsic motivation because they are considered controlling (Ryan & Deci 2000b:70) and in some cases, such as with evaluations, negative feedback will also undermine competence (Ryan & Deci 2017:148). The explanation for this is that they lead to an external locus of causality which ultimately decreases intrinsic motivation and increases extrinsic motivation (Ryan & Deci 2017:150)

External events which increase intrinsic motivation are those which provide people with a sense of volition; they feel they have a choice in which activity to do and in the manner in which they do it. This is because these events satisfy autonomy (Ryan & Deci 2017:150). In addition, tasks which present optimal challenges to individuals and are coupled with informational feedback also increase intrinsic motivation because they bolster competence (Ryan & Deci 2017:152). Games are particularly good examples of this (section 0).

Rewards in games are used to provide pleasurable experiences and to motivate players to continue playing (Salen & Zimmerman 2003:345). These rewards are primarily task-, performance- or competitively-contingent, but since they fall within the game system and are key components of a game (Koster 2004:120), they are not external events and therefore do not have the same negative effects discussed above (further discussed in section 2.1.3.4). The way in which rewards in games motivate players to continue playing is by providing feedback (Rouse III & Odgen 2005:12); particularly positive feedback on various levels which enhances feelings of competence (Rigby & Ryan 2011:23–25).

2.1.1.2.1.2 Proposition 4

The fourth proposition (Ryan & Deci 2017:160) of CET describes the effect of the interpersonal climate of an environment on the motivation of an individual within it. As an example of one such environment, Vansteenkiste, Lens and Deci (2006:21) compare autonomy-supportive and controlling educational environments. The former allows opportunities for choice and take the student's perspective into account. If a choice is constrained, then a meaningful reason is provided. In addition, feedback is timely and positive. In contrast, in controlling environments, coercive strategies like deadlines or tangible rewards are used, thus placing students under pressure. The proposition states that the climate of the environment is dependent on how well it supports the three basic psychological needs.

2.1.1.2.1.3 Summary of CET

CET shows that environments and events have the ability to facilitate or hinder the intrinsic motivation of a person either by supporting their psychological needs or failing to do so. The events themselves are not the cause of intrinsic motivation, but rather their functional significance or psychological meaning to the individual is what determines their effect (Ryan & Deci 2017:159). CET stresses the importance of questioning the motives behind events and rewards in order to ensure that they are viewed as informational instead of controlling.

2.1.1.2.2 Organismic integration theory (OIT)

Since not all activities can be intrinsically interesting to every person (Vallerand, Pelletier & Koestner 2008:112), it is necessary to explore how extrinsic motivation works. This is the underlying concept of organismic integration theory. The theory is based on the concept of internalisation (Deci & Ryan 2002:15; Vallerand, Pelletier & Koestner 2008:113). Internalisation is a process by which a person transforms an attitude or a belief that they have gained into a personal goal or value (Deci & Ryan 1985a:130). In OIT, internalisation is viewed as an active process, since it requires the individual to actively shift their perspectives in order to accommodate the environment. If this does not happen, they will be overpowered by the environment (Deci & Ryan 1985a:130).

The assumption is that if external motivation is used to encourage a person to perform an activity for which they are not intrinsically motivated, the person tends to internalise the activity's external regulation. This means that they integrate the external regulation of the activity with their sense of self and the extent to which this takes place will determine how autonomous the person will feel when performing the extrinsically motivated activity (Deci & Ryan 2002:15). This means that even though it is not always possible to facilitate intrinsic motivation in individuals, it is still possible to facilitate autonomous behaviour towards extrinsically motivated activities. Self-determination is the ideal outcome of the internalisation process (Deci & Ryan 1985a:131; Mageau & Vallerand 2003:885).

OIT views internalisation as a continuum instead of it either being present or not (Deci & Ryan 2002:15). As mentioned above, the more internalisation takes place, the more the behaviour becomes a part of the person, the more self-determined behaviour is supported (Aelterman, Vansteenkiste & Haerens 2018:2).

2.1.1.2.2.1 Types of extrinsic motivation

OIT has classified different types of extrinsic motivation as they appear on this continuum. This is shown in Figure 1. The different types of motivation are arranged from left to right in terms of the extent to which the behaviour is self-determined.

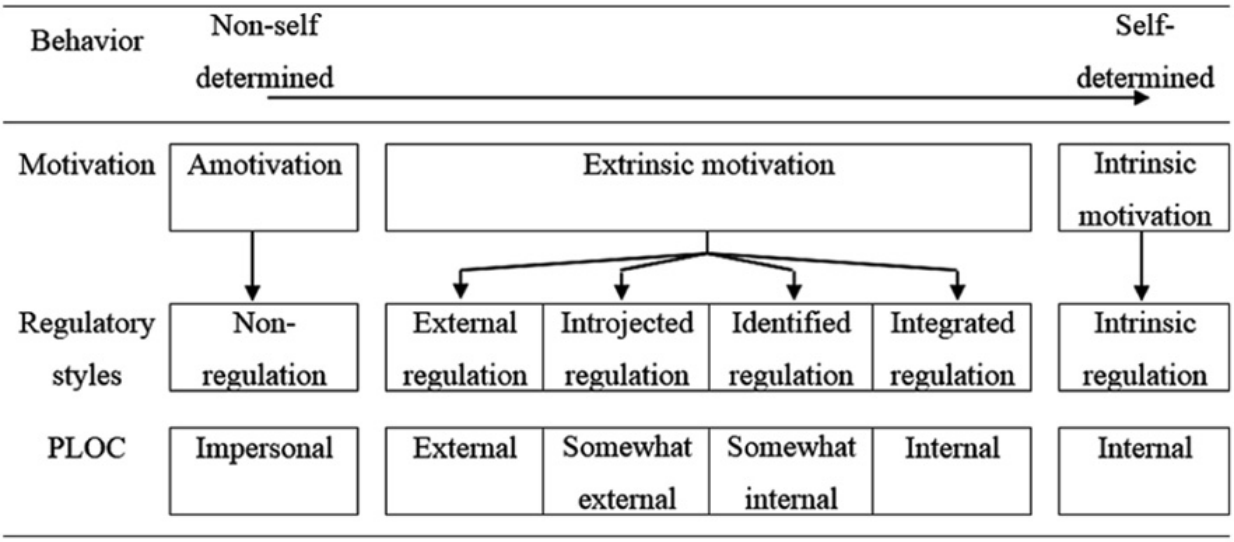

Figure 1 - The self-determination continuum showing types of motivation with their regulatory styles and loci of causality (Ryan & Deci 2000b:72; Deci & Ryan 2002:16)

On the far left is amotivation; the state of lacking the intention to act. Amotivated people either do not act at all or their behaviour lacks intentionality (Ryan & Deci 2000a:61). At the far-right end of the continuum is intrinsic motivation. It is considered the prototype of autonomous behaviour (Deci & Ryan 2002:17). In between intrinsic motivation and amotivation fall the four types of extrinsic motivation. As shown in the figure, when moving from left to right along the continuum, each type of extrinsic motivation is characterised by an increasing amount of internalisation as the PLOC shifts from external to internal. As a result, the behaviour becomes more self-determined and is more likely to be sustained (Deci & Ryan 2000:236).

Externally regulated behaviours are usually performed to obtain a reward or to satisfy an external demand. Without these external pressures, the behaviour will not be maintained (Deci & Ryan 2000:236). Introjected regulation describes behaviours where the control originates within the individual (Deci & Ryan 2000:236); examples include self-worth, pride or feelings of guilt. Although slightly more sustained than externally regulated behaviours, this is still not considered a very stable type of motivation (Deci & Ryan 2000:236).

Identified and integrated regulation are more desirable as they exhibit more self-determined behaviour due to the increasingly internal PLOC. Identified regulation involves a person voluntarily accepting a belief or behaviour because they view it as personally important or useful (Reeve 2009:134). Integrated regulation is the most autonomous type of extrinsic motivation. Here the regulations have been fully integrated with the individual's sense of self. This differs from identified regulation because the person has not only recognised the value of an activity, but they have also integrated it into their personal set of values and beliefs (Deci & Ryan 2000:236; Ryan & Deci 2000b:73). The activity is still extrinsically motivated because it is done to achieve some separate outcome, but it is fully self-determined.

An important aspect of the self-determination continuum is that it does not describe a developmental continuum (Deci & Ryan 2002:18). This means that a person does not necessarily move along it from start to finish, although this is also possible. A person can take in a regulation at any point on the continuum as long as the correct facilitating factors for that type of motivation are available (Deci & Ryan 2002:18). In addition, although intrinsic motivation forms part of the continuum, it does not imply that fully integrated extrinsic motivation will be transformed into intrinsic motivation; extrinsic motivation will always maintain its instrumental nature no matter the level of internalisation (Ryan & Deci 2017:197).

This continuum is important because it highlights the importance of facilitating internalisation. Since not every activity can be intrinsically motivated for every person, internalisation is important in these cases. This is especially relevant in contexts such as education where the subject matter may not intrinsically motivate every student.

2.1.1.2.2.2 Effects and facilitation of internalisation

There is clear empirical evidence of the positive effects of more internalised motivation (Ryan & Deci 2000b:73; Vansteenkiste, Niemiec & Soenens 2010:119). In a general sense, it leads to "more behavioural effectiveness, greater volitional persistence, enhanced subjective well-being, and better assimilation of the individual within his or her social group" (Ryan & Deci 2000b:73). The effects of internalisation on education are discussed in section 0.

The importance of internalised extrinsic motivation leads to the question of how to facilitate it. Since extrinsically motivated activities are not inherently interesting, the main reason why people engage in them is that those behaviours are modelled by people who are significant in the individual's life. Alternatively, the significant other could prompt the behaviour with a request or by offering a reward. The individual desires to feel attached to this person or already does feel

that way and therefore they engage in the behaviour in order to gain implicit or explicit approval for doing so (Ryan & Deci 2000b:73; Deci & Ryan 2002:19).

This shows that relatedness, one of the three psychological needs, is important for internalisation. Relatedness is less important for maintaining intrinsic motivation than it is for extrinsic motivation (Deci & Ryan 2002:19).

Relatedness alone is not enough to facilitate internalisation; competence and autonomy must also be fostered. If a person does not feel competent to perform a behaviour, they are unlikely to internalise the regulation, even if a significant other satisfies the relatedness that they require. Lastly, the process of internalisation can only take place properly if the individual feels freedom and choice to internalise the behaviour. This means that autonomy is also key to its facilitation (Deci & Ryan 2002:19–20).

In summary, internalisation, like intrinsic motivation, is facilitated through meeting the three psychological needs.

2.1.1.2.3 Remaining four mini-theories of SDT

This section provides a brief overview of the remaining four mini-theories of SDT. The primary focus of each of these mini-theories is the individual – their personality, well-being, goals and relationships. The focus of this study is the overall effect of gameful design on motivation; a focus on the inner resources and personality of the individual falls beyond the scope of the study.

2.1.1.2.3.1 Causality Orientations Theory (COT)

SDT is based on the assumption that a person's behaviour and motivation in a situation is a result of their environment as well as their inner resources that have developed from prior interactions. COT was developed to account for these inner resources (Deci & Ryan 2002:21). It resulted in the creation of the General Causality Orientations Scale (GCOS) (Deci & Ryan 1985b) which is used to index aspects of an individual's personality that have an effect on motivation. This is a complementary approach to motivation – CET focuses on the effect of the environment while COT focuses on the effect of the personality.

2.1.1.2.3.2 Basic Psychological Needs Theory (BPNT)

This mini-theory is a formalisation of the concept of the three psychological needs and how they relate to mental health and well-being (Deci & Ryan 2002:23). Ryan and Deci (2000b:75; 2002:24) suggest that the satisfaction of the three psychological needs is essential for an individual's well-being.

2.1.1.2.3.3 Goal Contents Theory (GCT)

GCT is an offshoot of BPNT which posits that some life goals have the ability to satisfy the three needs better than others (Deci & Ryan 2000:244; Ryan et al. 2009:116). Goals are separated into two categories – intrinsic goals and extrinsic goals. These are not synonymous with intrinsic and extrinsic motivation, but they are related.

Intrinsic goals are closely related to need satisfaction. Examples include personal growth and community contribution (Deci & Ryan 2000:244). Extrinsic goals tend to be focused on outcomes, rather than being inherently satisfying of the basic needs. They result in a person feeling worthy, for example, attaining wealth or image (Deci & Ryan 2000:244; Ryan et al. 2009:116). Intrinsic goals are named for being linked more closely to intrinsic need satisfaction and due to this, they are more strongly associated with well-being, as is shown by a number of empirical studies (Deci & Ryan 2000:244; Ryan & Deci 2000b:75).

2.1.1.2.3.4 Relationships Motivation Theory (RMT)

RMT focuses on relationship satisfaction. It posits that relatedness is a central component in a healthy relationship, but by itself is not able to ensure high-quality relationships. It must be accompanied by autonomy and competence within the relationship (Deci & Ryan 2014:56).

2.1.2 Flow theory

Flow theory was proposed by Mihaly Csikszentmihalyi in 1990 (Csikszentmihalyi 1990). It is aimed at understanding how to achieve happiness and it is a mini-theory of motivation because it only focuses on one aspect of motivation (Reeve 2009:35).

The theory refers to the concept of "flow" or the optimal experience as something that takes place when a person is in control of their actions and they feel a deep sense of enjoyment that occurs when they are challenged in order to accomplish something (Csikszentmihalyi 1990:3). This relates very closely to the psychological needs of autonomy and competence. Csikszentmihalyi (1990:4) supports this interpretation by stating that, "…in the long run optimal experiences add up to a sense of mastery – or perhaps better, a sense of participation in determining the content of life…". The sense of mastery here satisfies the need for competence while the sense of participation satisfies the need for autonomy. It is clear that self-determination theory and flow theory are quite closely linked (Deci & Ryan 1985a:29; Csikszentmihalyi 1990:5).

2.1.2.1 Characteristics of flow

Csikszentmihalyi identifies the components that are necessary for experiences of flow. They will be outlined below.

2.1.2.1.1 A challenging activity that requires skills

People have reported having experiences of flow while doing something without reason or challenge, but goal-directed and rule-bound activities are more likely to elicit these kinds of experiences (Csikszentmihalyi 1990:49). These are activities which require a person to have the appropriate skills in order to perform the activity (Csikszentmihalyi 1990:50). Games are particularly good at providing this component for flow because they are centred around providing players with challenges (Rigby & Ryan 2011:20). To put it differently, Suits (1978:24) describes games as "goal-directed activities in which inefficient means are intentionally chosen" and it is these inefficient means that create the challenge for the player. In addition, games are generally described as goal-directed and rule-bound (Avedon & Sutton-Smith 1971:405; Salen & Zimmerman 2003:80).

2.1.2.1.2 The merging of action and awareness

This occurs when a person is engaged in a challenging situation and is employing their skills. Their attention becomes completely focused on the activity and they have no energy to spend on the environment outside the activity (Csikszentmihalyi 1990:53). This is one of the most distinctive features of the optimal experience: "…people become so involved in what they are doing that the activity becomes spontaneous, almost automatic…" (Csikszentmihalyi 1990:53).

2.1.2.1.3 Clear goals and feedback

Clear goals and immediate feedback are what makes it possible for an individual to achieve the flow state. Games are very good at doing this, in fact this is part of how they are able to meet the psychological need of competence (Ryan & Deci 2017:514) (see section2.1.3.1). Salen and Zimmerman (2003:34, 337) describe this aspect of flow as related to the concept of meaningful play, in which meaning within the game emerges from the response of the game to the action of the player.

2.1.2.1.4 Concentration on the task at hand

Irrelevant or unpleasant thoughts that intrude on a person while they are performing an activity tend to ruin the enjoyment of the activity. For this reason, concentration on the task is a very important component of flow. This is also the reason why flow improves the quality of a person's

experience – they can perform an activity uninterrupted by stray thoughts (Csikszentmihalyi 1990:58).

2.1.2.1.5 The paradox of control

The paradox described here is the sense of being able to exercise control within a situation without being completely in control of it (Csikszentmihalyi 1990:61). Since games provide conflict or challenges the player can never completely control the outcome, but they can attempt to exercise control by taking actions within the game system (Salen & Zimmerman 2003:337).

2.1.2.1.6 The loss of self-consciousness

When a person is thoroughly absorbed in an enjoyable activity, they tend to lose a consciousness of themselves. Salen and Zimmerman (2003:337) describe this experience as the person becoming a part of the game system, instead of being an individual outside the game.

2.1.2.1.7 The transformation of time

Csikszentmihalyi (1990:66)mentions the accounts of hundreds of different people as they have experienced flow. A common description that was given with regards to the experience was the idea that time seemed to pass differently while they were engaged in the activity. This is not a major element of the experience, but it does tend to contribute to feelings of exhilaration elicited by the flow experience.

2.1.2.2 How flow experiences occur

In the study of flow experiences, it was found that the common factor was a transformation of the self, caused by an increase in complexity (Csikszentmihalyi 1990:74). This can be explained by Figure 2.

The figure shows the two most important dimensions of the optimal experience, skills and challenge, mapped on to a set of axes. The point A_1 to A_4 represent four points in time as a person is engaging in an activity such as playing a new game. At A_1 the person has just started playing the game and they do not yet have a thorough understanding of the rules (therefore their skill level is low). At this point, the challenges presented by the game should be low so that the difficulty level matches the skill level of player. If this is the case, they are likely to enjoy the game and experience flow. A_4 shows how the player is still in the flow channel because the game challenges have increased in proportion to their skill level. At A_3 and A_2, the game challenge has either increased too quickly (A_3), causing anxiety; or the player's skill has outgrown the challenge

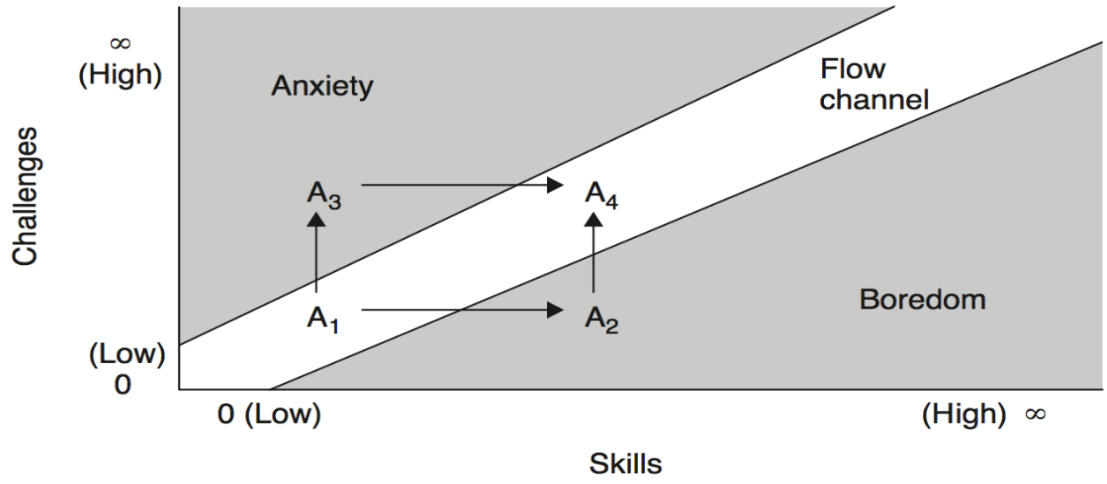

Figure 2 - Flow theory (Csikszentmihalyi 1990:74)

(A_2) and they have become bored. This shows that flow experiences occur at the intersection of balanced amounts of challenge and skill.

It now becomes clear why flow activities lead to individual growth. A person struggles to enjoy the same thing at the same challenge level for a prolonged period of time. The desire to experience enjoyment again leads to a person pushing themselves to improve their skills or discovering new challenges, both of which lead to personal growth (Csikszentmihalyi 1990:75).

The experience of flow is objective because it is based on personal perception. A person who is performing a flow activity is not only affected by the challenges presented by the situation but also by their own awareness of the challenges and their skill level. This means that performing a flow activity does not always result in an experience of flow (Csikszentmihalyi 1990:75).

2.1.2.3 The autotelic experience

The optimal experience is closely linked to the concept of intrinsic motivation. In fact, it represents some of the "purer instances of intrinsic motivation" and can be considered the representative of intrinsically motivating experiences. (Deci & Ryan 1985a:29; Deci & Ryan 1985a:155). One of the key characteristics of it is the fact that it results in the activity being done for its own sake, rather than for its consequences (Csikszentmihalyi 1990:67). The term that is used to refer to a self-contained activity such as this, which is performed only for the intrinsic reward that it provides, is autotelic (Csikszentmihalyi 1990:67). Games have also been described

as autotelic objects (Salen & Zimmerman 2003:331–332). This concept is explored in more detail in section 2.1.3.4.

2.1.3 Motivation in games

Having examined SDT, it is now possible to apply this theory of motivation to games in order to gain an understanding of how they are able to create motivating and engaging experiences.

The first three sections describe how the three psychological needs are satisfied in games. This is based on the work of Ryan, Rigby and Przybylski. In their book titled *Glued to Games: How Video Games Draw Us In and Hold Us Spellbound*, Rigby and Ryan (2011) apply the concepts of self-determination theory to games. Ryan, Rigby and Przybylski also developed The Player Experience of Need Satisfaction (PENS) (Ryan, Rigby & Przybylski 2006; Przybylski, Rigby & Ryan 2010; Rigby & Ryan 2011) measure which is used to provide evidence for need satisfaction in play. The conclusion that games are able to satisfy the three needs is supported by a study done by Peng et al. (2012) which manipulated features of an exercise game and found that it led to the corresponding need being satisfied. In addition, Tamborini et al. (2010:760) show that need satisfaction in entertainment media leads to enjoyment.

The final section clarifies the framing of intrinsic and extrinsic motivation as it applies to games.

2.1.3.1 Satisfying competence

Previous sections have shown that the need for competence is a desire for an optimal challenge that gives a person a feeling of mastery over their environment. Games are very good at this because challenges are a central component of their design (Salen & Zimmerman 2003:80; Fullerton 2008:76–78; Schell 2008:209) (the specifics of game challenges and motivation are discussed in section 0). Games contain four main elements which foster feelings of competence.

Firstly, they contain some form of adaptive challenges. These are called levels in some games (Ryan & Deci 2017:514). The purpose of this is to keep the player in the flow channel by balancing the skills they require with the difficulty of the challenge (Schell 2008:207). Fullerton (2008:34) describes this as follows: “Increasing the challenge as the game goes on can cause a rising sense of tension, or if the challenge is too great, it can cause frustration. Alternately, if the challenge level remains flat or goes down, players might feel that they have mastered the game and move on”. This is very similar to what is shown in Figure 2. By providing the player with an optimal challenge based on their personal capability within the game, feelings of competence are strengthened (Rigby & Ryan 2011:20). Feelings of mastery that arise when a challenge is

overcome are described by McGonigal (2011:33) as “fiero” or pride and, according to her, are the reason why people crave new challenges.

Secondly, games explain clearly what is expected of the player. Ryan and Deci (2017:514) refer to this as “clarity of goals” and these make it easier to achieve success in the game. This is coupled with the third element, that of instantaneous feedback. Assuming this feedback is positive and not controlling, it will be viewed as informational and therefore enhance intrinsic motivation (Ryan & Deci 2017:514). If implemented correctly, the feedback will help the player attain their goal and trigger feelings of pleasure (Schell 2008:262).

Finally, Przyblyski, Rigby and Ryan (2010:156) describe mastery of controls as something which stands between players and feelings of competence. If the process of mastering the game controls is too complex, players may get frustrated and give up. “Games that have complex controls and mechanics are said to have a ‘steep’ learning curve, and players generally do not enjoy this kind of engagement, instead viewing it as a price of admission to what is hoped will be future fulfilling game experiences” (Przybylski, Rigby & Ryan 2010:156). If the controls of the game are smooth and intuitive, players will be less aware of them and experience more mastery in their engagement with the game (Ryan & Deci 2017:515). This will also enable the merging of action and awareness as well as the loss of consciousness, two of the components of flow (section 2.1.2.1).

2.1.3.2 Satisfying autonomy

Games are able to satisfy autonomy in four main ways - identity, activity, strategy and open world design (Rigby & Ryan 2011:44–45).

Identity refers to the freedom to customise one’s own representation in the game. Many role-playing games, among others, offer this option. Sundar and Marathe (2010:304) argue that allowing the user to play an active role in this process increases their sense of agency which has a positive effect on their experience. A study by Kim et al. (2015) showed that customising a game character improved players’ feelings of control which positively affected their autonomy.

Secondly, activity refers to the way in which games allow players to choose their activities and roles. This means that there is freedom to choose where to travel to, which quests to do and how to customise one’s character. This also ties into open world design, which provides a large number of choices. Ryan and Deci (2017:516) explain that open worlds provide “opportunities for action” which result in high autonomy for the player.

Lastly, strategy satisfies autonomy because it allows the player to choose how to solve a problem. Przybylski, Rigby and Ryan (2010:156) calls this "equifinality" and describe it as the ability of a game to provide multiple routes to the finish.

Volitional engagement (Rigby & Ryan 2011:47) is also an important concept to consider because it explains how games are able to foster autonomy even if they do not provide open worlds or multiple routes to the end. "If we truly value the activity before us for its own sake – if it is personally interesting and important to us – we will feel autonomous even when choices and 'freedom' are constrained" (Rigby & Ryan 2011:47). This means that games with limited choices are still able to satisfy autonomy by piquing the player's interest using well-designed stories and interesting characters in order to keep them moving forward without feeling controlled.

In games, the concept of choice is closely linked to that of uncertainty (Salen & Zimmerman 2003:174). This means that the only way in which a player will feel as though their choices within the game have meaning is if they are unsure of the outcome of the game. Schell (2008:210) describes this as meaningful choices, "choices that will have a real impact on what happens next and how the game turns out". Salen and Zimmerman (2003:35) describe a similar concept of meaningful play, explaining how the actions of the player are integrated into the larger context of the game. This means that games with limited choices can still satisfy autonomy, as long as those choices are meaningful and can be seen to affect the outcome of the game.

2.1.3.3 Satisfying relatedness

The idea of single player games satisfying relatedness seems strange because the player is not interacting with anyone else whilst playing, but Rigby and Ryan (2011:69) describe how games are able to make a player feel like they matter even when they are interacting with non-player characters (NPCs) in it. This is because well-crafted NPCs are able to make a player feel relevant and show that they, the player, are needed. This can be done by speaking to the player and motivating them toward certain actions or accompanying them on a quest. These conversations with the NPC are able to satisfy autonomy by providing the player with opportunities for action as well to increase their feeling of volition which will make them more invested in the story (Rigby & Ryan 2011:71). This ties into the concept of meaningful choices discussed in section 2.1.3.2.

In multiplayer games, relatedness is satisfied by allowing a player to experience the game with other player-controlled characters (Ryan & Deci 2017:516). Many multiplayer games are built to reward teamwork, for example, raiding in World of Warcraft is impossible when attempted

alone. This increases the opportunities for mastery and competence because they allow players to feel like they have accomplished an even more difficult task than they would have if they had been playing alone (Rigby & Ryan 2011:74). Secondly, when teamwork is required, each player feels like an important part of the team, which increases feelings of relatedness.

2.1.3.4 Intrinsic and extrinsic motivation in games

It is necessary to define the meaning of intrinsic and extrinsic motivation within in the context of games. This is because game studies scholars tend to differ on their opinions in this area.

Schell (2008:150–151) is of the opinion that games employ a range of motivations to keep players interested. For example, a person playing a game for the pure delight of it is intrinsically motivated; however, if they are playing because the game awards them points, then they are extrinsically motivated. For example, in the game *Pac-Man*: a person playing for the thrill of racing through the maze is intrinsically motivated, while a person playing for the points awarded is extrinsically motivated.

Salen and Zimmerman (2003:331–332) differ from this view by suggesting that games are self-contained, autotelic objects. As Csikszentmihalyi (1990:67) puts it, "…the doing itself is the reward". The framing presented by Salen and Zimmerman (2003:331–332) is based on whether the game is played as a means to an end, or as an end in itself. Using the example given above, the reason why a person would furiously race through the maze, eat the dots and earn points is because they are playing *Pac-Man*. The play of the game does not fulfil any external purpose and therefore it is considered intrinsically motivating.

This difference in opinion should be viewed as a difference in framing. The view of Salen and Zimmerman can be supported when one considers what place rewards have within the context of a game. Section 2.2.3 discusses the action > outcome molecules as the means by which games implement interactivity. The action part of the molecule refers to the player's interaction with the core mechanic while the outcome would be the manner in which the game responds to the action by either punishing or rewarding the player (Salen & Zimmerman 2003:344). What this means is that rewards, like the points referred to by Schell (2008:150–151), are an integral part of gameplay. If a player chooses to play the game because it rewards them with points, then they are still intrinsically motivated by the points because these are part of the game itself. Additionally, if awarding a player with points causes them to continue playing the game, they are still intrinsically motivated for the same reason stated above. Returning to the meaning of intrinsic motivation – "…the doing of an activity for its inherent satisfactions…" (Ryan & Deci 2000a:56)

– it can be concluded that rewards in a game are an important part of the inherent satisfaction that they provide.

There is, however, a point at which a line must be drawn. Salen and Zimmerman (2003:332) also state that there are always extrinsic reasons for playing a game, but that most often, the intrinsic reasons are the prime motivators. Returning to the example of *Pac-Man*, if a person plays the game primarily to beat their friend's high score with the intention of claiming bragging rights, then their motivation to play has shifted to extrinsic. In this case, the type of motivation would be introjected regulation because the behaviour is performed to attain an ego-enhancement, namely pride (Ryan & Deci 2000b:72). However, a person who plays *Pac-Man* because they enjoy it, but also compares their scores with those of their friends would still be considered to be primarily intrinsically motivated.

In summary, the framing of intrinsic motivation in games used in this study is the same as that which is presented by Salen and Zimmerman (2003:331–332). Rewards are an important part of games and therefore are not considered extrinsic motivators in and of themselves. However, if the player uses the reward as a reason to obtain something outside the game then it has become an extrinsic motivator.

2.1.4 Summary of motivation

This section has dealt with self-determination theory, focusing specifically on the mini-theories of cognitive evaluation theory (for an understanding of intrinsic motivation) and organismic integration theory (for an understanding of extrinsic motivation). Flow theory has also been discussed as one of the ways in which games are able to craft optimal experiences. Section 2.1.3 has combined all of the above by discussing SDT in the context of games. It is clear that games are inherently very good at satisfying the three needs. This property of games is the reason why gamification has become such a popular concept.

2.2 Games

A brief look at the game studies literature is necessary to establish a background for the upcoming discussion on gamification. This is because gamification is directly linked to the concept of games.

There are various existing definitions for what a game is (Crawford 1984:7; Salen & Zimmerman 2003:79; Koster 2004:14; Costikyan 2005:196). However, for the purposes of this dissertation, it is

sufficient to define a game as "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (Salen & Zimmerman 2003:80).

It is necessary to address the concepts of mechanics, conflict and outcomes, as these will apply to sections addressed later in this review

2.2.1 Mechanics

The mechanics of a game are widely discussed in the literature (Salen & Zimmerman 2003:316; Koster 2004:122; Fullerton 2008:214; Schell 2008:157; Brathwaite & Schreiber 2009:6; Egenfeldt-Nielsen, Smith & Tosca 2009:39; Adams 2013:286). In a general sense, they refer to the underlying structures, procedures and tools that a player uses to interact with the game (Hunicke, LeBlanc & Zubek 2004). Since this topic has been discussed on a number of different levels, it is necessary to consult various definitions to gain a thorough understanding of the concept.

The MDA (mechanics, dynamics, aesthetics) framework presented by Hunicke, LeBlanc and Zubek (2004) provides one perspective on game mechanics. The framework defines mechanics (M) as "the various actions, behaviours and control mechanisms afforded to the player within a game context" (Hunicke, LeBlanc & Zubek 2004). The mechanics work together to support the game's dynamics (D), which manifest during the game when the player interacts with the mechanics. This interaction results in the aesthetics (A), which are the emotional responses of the player as they play the game. From this perspective, the mechanics of the game consist of the underlying structures with which a player will interact. As Adams (2013:36) puts it, "mechanics generate the gameplay". This is supported by the definition of mechanics supplied by Sicart (2008) which is "methods invoked by agents for interacting with the game world". This definition is primarily based on the concept of object-oriented programming, where a method allows an agent to access the data within another object. In this sense, a game mechanic is an action that allows an agent, whether human or computer-based, to interact with the game world (Sicart 2008).

If mechanics are viewed in a less formal way, the definition proposed by Schell (2008:51) would be fitting: mechanics are "the procedures and rules of your game. Mechanics describe the goal of your game, how players can and cannot try to achieve it, and what happens when they try". Lundgren and Björk (2003) propose a similar definition by positing that a mechanic is one type of interaction that can take place within the game.

Mechanics exist on varying levels of importance within the game system. Some authors refer to the concept of 'core mechanics' as those that are the most essential to the game and that interact with the less important mechanics (Adams & Dormans 2012). Salen and Zimmerman (2003:316) define the core mechanics of a game as "…the essential play activity players perform again and again in a game". The distinction between core mechanics and less integral mechanics is not clearly defined by the literature (Adams & Dormans 2012).

Authors in the field do not agree on whether mechanics are part of the rules of a game or whether they represent a different entity in themselves. Lundgren and Björk (2003) and Koster (2004:122) both refer to mechanics as part of the rule set of a game. Adams and Dormans (2012) state that they are related concepts, but that mechanics are more concrete, in the sense that they include everything that affects the operation of the game. In a general sense, the rules of the game are known to the players while the mechanics are hidden from them. The most apt distinction is given by Sicart (2008), which says that mechanics are restrained, or limited by the rules that apply within the game world. Järvinen (2008:74) suggests referring to game mechanics as verbs that describe how a player interacts with the systems, for example, shooting, running and climbing. From this perspective, rules would then affect the way those verbs work within the game.

In summary, there are various points of view on how a game mechanic should be defined and whether it should be considered part of the rule set or not. Regardless of the perspective, in a broad sense, a mechanic is the underlying system of a game with which the player interacts. This makes it one of the most important components of the game system.

2.2.2 Conflict and challenges

Conflict exists in some form in all games (Crawford 1984:14; Costikyan 2005:198), which is why it is considered a core component of a game. Games are built in such a way that their goals are difficult to achieve. This relates to the idea of the lusory attitude as defined by Suits (1978:38). The lusory attitude describes the willingness of the player to accept the rules of the game which often require them to use inefficient means to attain the goal.

This means that the conflict is directly linked to the goal of the game (Konzack 2002:94) and that it is created by the rules of the game (Fullerton 2008:77). If the goal of a game was changed to be as easy as possible to attain, all sense of struggle and conflict would be removed and a player would not feel a sense of achievement when they attain the goal (Fullerton 2008:77). Conflict

arises in a game when players struggle to attain a goal, whether they struggle together, in parallel or in opposition to each other (Salen & Zimmerman 2003:250).

It is important to structure the conflict and challenges in a game properly so that a player can experience flow (section 2.1.2). This means that the challenges must balance a player's skill level, but also increase steadily over time (Salen & Zimmerman 2003:351; Schell 2008:142, 209).

2.2.3 Actions and outcomes

Players progress through a game by making a series of choices. Each choice results in an action, which then leads to another choice. Salen and Zimmerman (2003:62) refer to this as "choice molecules" which consist of "action > outcome" units. The actions which a player performs requires them to engage with the mechanics of the game.

As a player uses the core mechanic of the game in order to overcome obstacles, they attempt to achieve certain sub-goals (Konzack 2002:94; Salen & Zimmerman 2003:343). Adams (2013:253) refers to this as the "hierarchy of challenges" in which "atomic challenges" must be completed in order to complete a sub-mission and sub-missions are completed to finish the game. This means that the sub-goals build upon each other to lead to the ultimate goal of the game. The goal of a game is a crucial element. The difference between games and less formal types of play is the fact that games have goals and a quantifiable outcome (Salen & Zimmerman 2003:342). The goal is the reason that players play the game and it motivates them to move forward in the game (Salen & Zimmerman 2003:342; Fullerton 2008:29).

The achievement of sub-goals leads to rewards, while the failure to achieve them may lead to punishment. Rewards and punishment are important in a game because they provide pleasure and motivate the player to continue playing (Salen & Zimmerman 2003:345). Schell (2008:220–221) outlines the different types of reward categories that are found in games: praise, points, prolonged play, a gateway, spectacle, expression, powers, resources, status and completion. He also mentions that based on psychology, specifically operant theory (Skinner 1963) (section 0), if the same reward is given every time, players tend to get bored (Rouse III & Odgen 2005:15). Two ways to solve this are to increase the reward given or to give variable rewards. With regards to punishment, Schell (2008:222) explains that it can increase the enjoyment of a player, but that it is important that it is administered properly. It should only be given for game actions that a player can understand and prevent, otherwise they will feel that it was unfair (Schell 2008:224). If balanced correctly, punishment gives a game more meaning and allows players to feel a greater sense of accomplishment when they succeed at something in the game (Schell 2008:225).

2.2.4 Summary of games

This section has covered the game design concepts that are helpful in order to gain a thorough understanding of how games work. The following section examines the concept of gamification – when games are used for purposes beyond entertainment.

2.3 Gamification

Gamification is the primary focus of this dissertation. This section will cover the origins and definition of the term, followed by a discussion of the concept of gameful design as a way to effectively harness the power of games in non-game contexts.

2.3.1 Precursors and origins of gamification

The development of the personal computer in the 1970s and 1980s led to growth in the video game industry as games moved from console and handheld platforms to computers that users could have in their homes (Malliet & de Meyer 2005:33). This industry, in turn, affected the HCI (Human-Computer Interaction) field as practitioners sought to find ways to improve the design of interfaces through the use of lessons learnt in other fields. One such example is found in the work of Carroll and Thomas (1982) and Carroll (1982) which suggested using metaphors to make the interface of a computer easier to use and furthermore, using lessons learnt from a text-based game called Adventure to aid the design of computer interfaces. Although it is an early example, Carroll (1982) identified a number of ways in which the game was able to motivate and teach the player better than the interface of a text editor. More recent research (Stott & Neustaedter 2013:2) on the effectiveness of games in gamified learning applications has also highlighted similar concepts.

Malone (1981) also contributed to this vein of research by compiling a framework of intrinsically motivating instructions which involved determining what made computer games captivating and attempting to apply these aspects to the area of learning with computers in order to make the task more interesting.

As the field of HCI matured and the term “user experience” was coined in 1995 (Norman, Miller & Henderson 1995), more researchers began to study methods of improving the quality of the experience of using technology and provoking various emotions within the users. For example, research was done into provoking feelings of fun or “funology” (Schneiderman 2004:48), also described as “the science of enjoyable technology” (Blythe, Hassenzahl & Wright 2004:37). The

aim was to blur the boundaries between work and play (Blythe, Hassenzahl & Wright 2004:37). Games also began to be used for purposes other than entertainment, a field known as 'games with a purpose' (GWAP) (von Ahn & Dabbish 2008). In addition, game interfaces were used to perform non-game tasks, as demonstrated by Chao (2004).

Playful design also became a popular research focus (see section 2.3.3.2). Gaver introduced the terms "*ludic* design" and "*ludic* activities" to echo the ideas of Huizinga (1949:1) when he said that humans are playful creatures. As such, Gaver (2004:886) posits that people do not engage in playful activities merely for entertainment, but to develop new values and goals as well as to learn something or gain new understanding. There is therefore a need to design interfaces and devices which meet both utilitarian and *ludic* needs.

From the review above, it can be seen that games have been used for a variety of purposes in the field of user experience. They have informed the design of interfaces and led to the research areas of funology, playful design and ludic design among others.

The term "gamification" itself is relatively new, having only been in use since 2008 (Paharia 2012). Before it was coined, game elements were being used in customer loyalty programs to encourage participation by appealing to the brain's reward system (Hughes & Lacy 2016:314). Gamification could therefore be viewed as "a digital gloss on long-standing incentive schemes" (Hughes & Lacy 2016:314). This is clear to see when one considers that a factor that enabled its creation and growth was the increasing number of web 2.0 businesses that struggled to motivate their users to sign up for the services that they were offering. The use of game design was one of the options that were explored to solve this problem (McGonigal 2014:30).

Slowly, various gamified applications began to emerge - *Nike+* in 2006, a mobile application that gamifies running; *StackOverflow* in 2008, a question-and-answer website for software development that includes points and badges as well as *Foursquare* in 2009, which added badges and leaderboards to the activity of checking in to a location.

Robson et al. (2015:412) suggest that the increased interest in gamification today is due to the growth of the computer game industry, the pervasiveness of social media and the desire of businesses to find new ways to connect with and influence their employees or customers. It would also not be amiss to posit that the reason why gamification is so popular in education (Hamari, Koivisto & Sarsa 2014:3029; Seaborn & Fels 2015:27) is because the rise in the popularity of games has caused educators to question why students are willing to spend hours

playing games and how that same motivation can be harnessed and applied in learning situations.

2.3.2 Defining gamification

There are currently three peer-reviewed definitions for gamification (Seaborn & Fels 2015:17; Huotari & Hamari 2016:23). Table 2 shows these definitions.

	Source	Definition
1	Deterding et al. (2011:10)	The use of game design elements in non-game contexts.
2	Huotari and Hamari (2012:19; 2016:25)	Gamification refers to a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation.
3	Werbach (2014:1)	The process of making activities more game-like.

Table 2 - The three peer-reviewed definitions of gamification

The definition proposed by Deterding et al. (2011:10) is the chosen definition for this dissertation. It is the most broadly-accepted definition for gamification (Seaborn & Fels 2015:16). It was chosen because of its firm grounding in game studies literature, which is the underlying perspective of this study. It also proposes trying to design for a particular experience instead of simply applying game elements to a problem. This is the very important concept of gameful design, which is discussed in detail in section 0. In addition to these reasons for choosing this definition, the other two definitions are less appropriate for this particular study for the reasons examined below.

Definition 2 is based on a background of service marketing literature. When compared to definition 1, the two definitions differ in a number of ways - specifically, the fields by which they are influenced, the type of contexts which can be gamified and the manner in which gamification should take place. Definition 2 was not chosen for this dissertation because of its service marketing background. This dissertation is focused on tertiary education and education cannot be considered a service.

The definition provided by Werbach (2014:1) views gamification as a process. It differs from definition 1 by its delineation of the context which can be gamified. Definition 1 also has a firmer basis in game studies and it addresses the problem of shallow implementations by introducing the concept of gameful design.

Having established the reasons for choosing the definition of Deterding et al. (2011:10) as the definition which will inform this study, it is necessary to discuss it in more detail in order to grasp the underlying game design parallels. In the following section, the concepts of game, elements, design and non-game contexts are covered.

2.3.2.1 Games and play

The concept of gamification stems from games (section 2.2), which are a subset of the larger phenomenon of play. These two terms are interrelated and require further explanation.

The concept of play is explored in detail by the historian Johan Huizinga in his book titled *Homo Ludens: A Study of the Play Element in Culture*, first published in 1938. The book was translated into English in 1949. Huizinga (1949:13) describes play as a free activity which takes place outside of the boundaries of normal life. Within its own boundaries, play has rules which are followed in an orderly manner. The activity of play results in no material goods or wealth, which makes it completely unproductive. In his book titled *Man, Play and Games*, originally published in French in 1958, philosopher Roger Caillois adds that the outcome of play is uncertain and that it has some element of make-believe included in it (Caillois 1961:9–10). Huizinga approaches play from a cultural perspective, while Caillois approaches it from the perspective of games.

Furthermore, Caillois (1961:13) introduces two terms that fall on opposite ends of the play continuum: *paidia* and *ludus*. *Paidia* is used to refer to free, spontaneous and unstructured types of play. Two young animals chasing each other or a child laughing at a toy are examples of *paidia*. When these *paidic* activities become bound by rules and conventions which result in an increasing difficulty to attain the desired goal, they have moved along the continuum towards ludus, which is the rule-bound and structured form of play, more commonly referred to as games.

This relationship between play and games has two aspects. In the first, games are a subset of play and in the second, play is a subset of games (Salen & Zimmerman 2003:72–73). When games are a subset of play, the play activities outside the realm of games fall within the category of *paidia*. Activities within in the category of games, that is, *ludic* activities, exhibit the second aspect of the relationship in which play is a subset of games. From this perspective, the activity is rule-bound and formalised as a game and play is one of the components of the game.

As stated at the start of this section, gamification is related to games. With the above background, it is possible to be more specific and say that gamification is related to ludus. The increase in the use of games and play for purposes beyond entertainment (Deterding 2012:122) has led to

designing systems in order to capture the essence of either play or games. The use of playfulness in HCI research is aimed at creating more engaging and memorable experiences for users (Lucero & Arrasvuori 2010:28; Lucero et al. 2014:36). These experiences are related to *paidic* activities. It is therefore then also possible to design systems aimed at eliciting experiences similar to *ludus* or games. The term "gamefulness" was introduced by McGonigal (2011:27) as a complement to playfulness. It refers to the qualities afforded by games. Since gamification is more strongly related to games (*ludus*) than to play (*paidia*), it can then be concluded that gamefulness is the experiential quality that a gamified system would be expected to give rise to (Deterding et al. 2011:11).

2.3.2.2 Elements

As the definition states, gamification uses game design elements. This is the main distinction between gamification and proper games - gamification only uses elements of games. There are two issues raised in this regard.

The first is the fact that is impossible to separate game design elements from other design elements (Deterding 2014:313). It is possible to use either a narrow interpretation by using elements that are unique to games alone or a broad approach of using elements found in any game (as well as other potential applications). The former will result in a very small set of elements while the latter would provide too many elements. This dissertation agrees with the stance of Deterding et al. (2011:12) which is to use elements which are characteristic of games, those that significantly impact the gameplay.

While the delineation of game elements is important in the context of the definition of gamification, it should not be the main deciding factor when choosing how to gamify a particular context. Criticism towards gamification has contended that it tends to take the parts of games that are the least important and use them to attempt to elicit the same emotions as a game does (Robertson 2010). As gameful design clarifies, it is not so much about which game elements to use as it is about affording the experience of gamefulness. While this is often done using game elements, a designer should not narrow their thinking by approaching the process of gamification from the perspective of adding game elements to a system. They should rather approach the system with the goal of designing it to afford *ludic* qualities. The difference between the interlinked terms of gamification and gamefulness is further discussed in section 0.

The second issue that should be discussed is that the boundary between a gamified system and a full game is not always clear because it is dependent on the context and the users. One of the

components of a game is the social world that exists outside it (Taylor 2009:332) which means that players impose their own perspectives on the game, affecting their view of it. In the context of a gamified system, this means that even though a designer does not intend it to be a full game, it could be viewed as such by the users. A group of friends could choose to play or use *Zombies! Run* (https://zombiesrungame.com) depending on their perspective. Deterding et al. (2011:11) support this view by mentioning that one the defining characteristics of a gamified system is that it presents the user with a variety of different experiences – moving between the modes of playful, gameful and other more formal types. This differs from a game which provides a stable *ludic* experience (Deterding et al. 2011:12).

2.3.2.3 Design

Games have been used for a variety of purposes in the field of human-computer interaction (HCI). Studies have been done on using game interfaces and controllers in work contexts (Chao 2001) as well using game engines and authoring tools for non-game purposes (Jacobson 2003; Lepouras & Vassilakis 2004). The wide use of games for different purposes shows the necessity of specifying that gamification uses game *design*, not game-based technologies or game-like concepts.

With this being established, it is also necessary to provide a differentiation of the types of game *design* elements that have been identified. Deterding et al. (2011:12) provide a classification of five levels of game elements, in order of level of abstraction.

Level	**Description**	**Example**
Game interface design patterns (Crumlish & Malone 2015)	"Common, successful interaction design components and design solutions for a known problem in context" (Crumlish & Malone 2015:10)	Levels; leaderboards; points; avatars
Game design patterns and mechanics (Björk & Holopainen 2006)	"…descriptions of commonly reoccurring parts of the design of a game that concern gameplay" (Björk & Holopainen 2006:425)	Resources, mutual goals; shared rewards; stimulated social interaction

Level	Description	Example
Game design principles and heuristics (Desurvire & Wiberg 2009)	"Evaluative guidelines to approach a design problem or analyse a given design solution" (Deterding et al. 2011:12)	Enduring play; goals; challenge, strategy and pace
Game models (Hunicke, LeBlanc & Zubek 2004; Brathwaite & Schreiber 2009:25; Calvillo-Gámez, Cairns & Cox 2009)	"Conceptual models of the components of games or game experience" (Deterding et al. 2011:12)	MDA; core elements of the gaming experience (CEGE); game design atoms
Game design methods (Fullerton 2008; Belman & Flanagan 2010)	"Game design-specific practices and processes" (Deterding et al. 2011:12)	Playtesting; playcentric design; value conscious game design

Table 3 - Levels of Game Design Elements (adapted from Deterding at al. (2011:12))

The first level is game interface design elements. These are considered the most concrete types of game elements. Crumlish and Malone (2015) identify a number of interaction design components and patterns in the context of designing social web interfaces. For every pattern covered, an explanation is given, which includes why the pattern should be used, when and how to use it and any accessibility issues that should be considered. This makes it clear that each pattern can be applied to a very specific situation in order to solve a specific problem. This is why this is the least abstract level in the table of game elements. Deterding et al. (2011:12) calls this "prototypical implemented solutions".

The game elements referred to as patterns by Crumlish and Malone (2015) include levels, leaderboards, points, avatars and achievements. While the source is not primarily about designing for games, it can be used as a level of game elements in the classification because the relevant elements mentioned are also characteristic to games, which fits the chosen definition of game elements provided in the section 2.3.2.2. An example of a pattern is levels (Crumlish & Malone 2015:157). This pattern is used in social interfaces to show users how far they have

progressed and it allows them to compare themselves to other users (Crumlish & Malone 2015:157).

This level of abstraction of game elements is, unfortunately, the one where most gamified implementations begin and end. This is the main criticism towards gamification – that it uses the simplest elements that can be borrowed from games, even though they are the least essential to the game (Bogost 2015:68). Criticism on gamification is discussed in section 0.

The second level of the table is game design patterns and mechanics. This level seems very similar to the previous level of game interface design patterns. They are kept separate because of their varying levels of abstraction. The former does not refer to implemented solutions while the latter does. Björk and Holopainen (2006:424) specify that their design patterns are not presented as problem-solution pairs because it could result in them being used as problem-solving tools, instead of designers relying on them to support creativity. Secondly, more than one pattern could easily be used in a given context to solve a problem. One example of a design pattern identified by Björk & Holopainen (2006:427) is resources. Resources allow players to perform actions in a game. Depending on the game, there are rules governing how they are earned, stored and spent.

Similar to game design patterns, game mechanics are also aspects of a game which relate to the gameplay and are reoccurring within the system. This is why they also form a part of this level of abstraction. Game mechanics are described in section 2.2.1.

Game design principles and heuristics form the next level of abstraction of game elements. Desurvire and Wiberg (2009), among others, developed a set of heuristics which can be used to evaluate games.

Game models like the MDA framework (Hunicke, LeBlanc & Zubek 2004) or the CEGE (Core Elements of the Gaming Experience) (Calvillo-Gámez, Cairns & Cox 2009) form the fourth level of game elements and game design methods such as playcentric design (Fullerton 2008) form the final, most abstract level, of game design elements.

This classification of game elements shows that there is a rich variety of elements and levels of abstraction of game elements that can be used in gamification. This lends some credibility to the criticism of the approach to only use points, badges and leaderboards in an implementation when it is clear that there can be much more depth to a game than those simple elements.

2.3.2.4 Non-game contexts

It is possible to assume that the primary purpose of games is for entertainment. It then follows that a non-game context could be any situation in which entertainment is not the primary goal. For example, education, marketing or health. In gamification, the primary purpose is currently motivation towards some end or improvement of the user experience (Deterding et al. 2011:12; Seaborn & Fels 2015:14).

The delineation of non-game context excludes the use of gamification within a game as that would still be considered game design. Deterding et al. (2011:12) support this in the following statement: "…part of the novelty and distinctness of 'gamified' systems is the experiential 'flicker' between gameful, playful and other modes of experience and engagement. Such flickers are arguably less likely to occur when the user is already playing a game".

2.3.3 Situating gamification

Having clarified the definition of gamification, it is possible to compare it to related concepts using the relationships of *ludus* versus *paidia* and parts of a game versus a whole game. The two main concepts which need clarification here are serious games and playful design.

2.3.3.1 Serious games

An agreed-upon definition for serious games has yet to be established (Susi, Johannesson & Backlund 2007:1; Kankaanranta & Neittaanmäki 2008:v). Most scholars refer to that proposed by Abt (1970) which was the first work on the topic of using games for purposes other than fun (Breuer & Bente 2010:8). Abt (1970:9) explains that serious games "have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining". It is clear that Abt considers a serious game to revolve around education. Some sources have agreed with this definition (Michael & Chen 2005:17; Ratan & Ritterfeld 2009:11) while others have approached the topic from a broader perspective. Susi et al. (2007:1), for example, states that the purpose of a serious game is something other than entertainment while not specifically mentioning that the purpose is education. The difference in definitions potentially stems from the way authors frame their understanding of education. As Michael and Chen (2005:17) explain, education "in its various forms" is the goal of a serious game.

For the purposes of this dissertation it is merely necessary to establish what a serious game is considered to be in the literature so as to distinguish it from gamification. It is therefore most

important to understand that education is an important concept in serious games. Kankaanranta and Neittaanmäki (2008:v) explain that serious games "usually teach the user something". This leads to the offshoot of various sibling concepts which should also be defined.

The first is edutainment. This is a term which was used frequently in the 1990s when it first became popular to have a personal computer in one's home. This lead to the development of games specifically for the purpose of education (Michael & Chen 2005:24), for example, the JumpStart games range (http://www.jumpstart.com/). The term edutainment refers to the method of "education through entertainment" (Michael & Chen 2005:24). Most scholars agree that edutainment games are a subset of serious games (Michael & Chen 2005:24; Ratan & Ritterfeld 2009:11; Breuer & Bente 2010:10). The fact that edutainment games focus on reinforcement learning tends to make them boring (Van Eck 2006:3). In addition to this, they were potentially associated with learning theories that do not correspond with current ideas about learning (Meyer & Sørensen 2009). These points are most likely the reason why edutainment games were not profitable (Susi, Johannesson & Backlund 2007:2).

The second related term that should be explored is game-based learning (GBL). This refers to the use of a game for educational purposes (Breuer & Bente 2010:11). It can be distinguished from serious games because serious games can also be used for purposes other than education, such as political games which are used for persuasion (Michael & Chen 2005:204) or art games which are primarily used as a means of expression for the artist (Michael & Chen 2005:221). However, it can be argued that the use of games for political or artistic purposes is simply a different form of education, a type of attitude transfer (Michael & Chen 2005:203), instead of knowledge or skill transfer as one would expect of a traditional educational game. Indeed, some sources consider game-based learning and serious games to be interchangeable concepts (Susi, Johannesson & Backlund 2007:2). Digital game-based learning (DGBL) is similar to GBL but it is restricted to the digital medium, which makes it a subset of e-learning (Susi, Johannesson & Backlund 2007:2). E-learning is a combination of digital media and learning (Breuer & Bente 2010:11).

The distinction provided in Figure 3 clarifies these related concepts well. Breuer and Bente (2010:11) defines entertainment education as any attempt to make learning more enjoyable. GBL

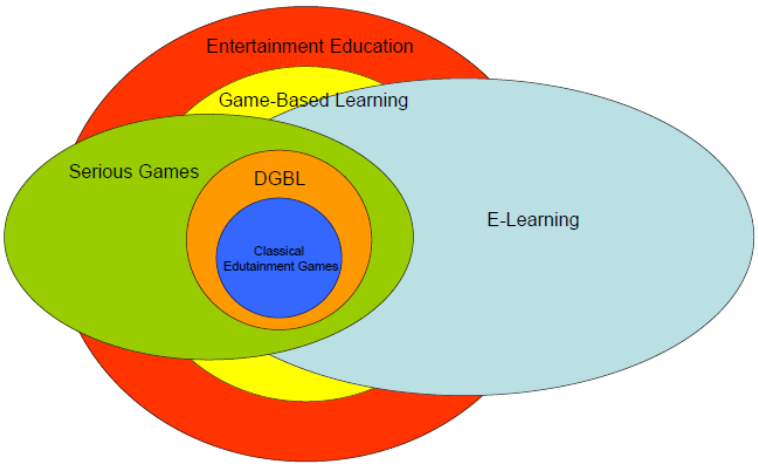

Figure 3 - The relations between serious games and similar educational concepts (Breuer and Bente 2010:11)

and DGBL is therefore a subset of this, as is edutainment. E-learning and serious games extend beyond this category because they can also be used for purposes other than entertainment education, for example, the use of serious games for therapy (Breuer & Bente 2010:11).

Despite the lack of agreement upon a single definition for serious games, it is possible to distinguish from the literature that all sources are in agreement with the fact that serious games are indeed fully-fledged games. The same can also be said for game-based learning applications.

2.3.3.2 Playful design

Playful design could be considered the *paidic* complement to gamefulness since the latter involves *ludic* qualities (Deterding et al. 2011:11). From this perspective, games are viewed as a subset of the larger category of play (Salen & Zimmerman 2003:72) (also discussed in section 2.3.2.1). This means that activities which fall outside the realm of games because they do not meet the definition of a game, fit within this larger category (Salen & Zimmerman 2003:303). Playful design therefore relates to the free, unstructured form of play, also known as *paidia*.

Fullerton (2008:92) describes playfulness as "a state of mind, rather than an action", which means that technologies designed with playfulness in mind are attempting to elicit a playful reaction or experience from users (Arrasvuori et al. 2011). It involves users approaching a technology with a *paidia*-like attitude which includes viewing it as not being serious, having no

clear goal and not having real-world consequences (Lucero et al. 2014:36). An example of playful design is a staircase in a metro station in Stockholm which plays piano key sounds when a person steps on each stair. Its goal is to motivate people to take the stairs instead of the escalator (Lucero et al. 2014:36). A framework of playful experiences (PLEX) was developed by Lucero et al. (2013) as a guide to be used in playful design. It is a categorisation of 22 playful experiences and it includes experiences such as "expression", described as "manifesting oneself creatively" or "discovery", described as "finding something new or unknown" (Lucero et al. 2014).

2.3.3.3 Situating gameful design

As discussed in section 2.3.2.2, gamification only contains elements of games and is not a full game as befits the definition of a game discussed in section 2.2. On the other hand, serious games and game-based learning implementations are regarded as proper games that meet this definition. It then follows that while both gamification and serious games fall within the *ludic* or gaming category, the former consists only of parts of games while the latter is a game as a whole.

When comparing gameful and playful design, it becomes clear that both contain elements from games and that neither constitutes a full game. Both relate to play, but gameful design relates to the *ludic* qualities of play while playful design relates to the *paidic* qualities of play. Figure 4 shows the relationship between serious games, gameful design and playful design as discussed above. The directions of the arrows in the diagram and the references to the "ludification of culture" and the "cultivation of *ludus*" will be discussed in the next section.

2.3.3.4 Ludification of culture and the cultivation of ludus

The current understanding of the concepts games and play is changing. This is largely due to the generations of people that have grown up around games who are continuing to play into adulthood (Stenros, Montola & Mäyrä 2007) and it has resulted in play becoming an activity that forms part of our everyday lives (Bouça 2012). In addition to this, play and games are becoming, in and of themselves, important elements of art, belief, knowledge and custom (Bouça 2012). This impact of games on culture has become known as "*ludification*" (Bouça 2012), "*ludification* of culture" (Raessens 2006) or the "*ludic* century" (Zimmerman 2004). The *ludification* of culture also involves the emergence of play in areas of society which were previously thought to be the opposite of play, such as the fields of education and the military (Raessens 2010:6). This effect of games on culture is indicated by the outgoing arrows in Figure 4.

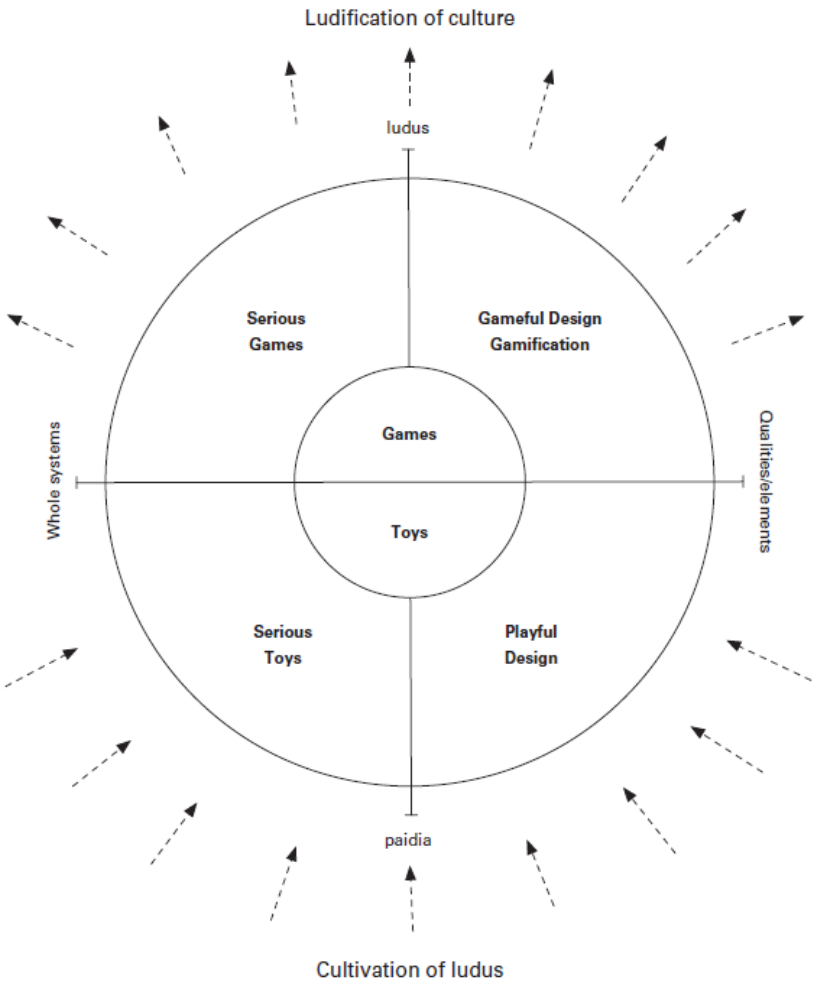

Figure 4 - A conceptual mapping of the gameful world (Walz & Deterding 2014:8)

The logical complement of *ludification* of culture can be termed the "cultivation of *ludus*" (Walz & Deterding 2014:7). This is the concept of games and play being affected by the culture around them (as indicated by the incoming arrows in Figure 4). This includes the use of the power of games for other purposes, of which gamification is one example (McGonigal 2014:24). Deterding and Walz (2014:7) argue that while some game scholars may find this distressing and consider it a misuse of games, it would make sense that if games and play are expected to impact culture, they would be impacted by it in return.

2.3.4 Applications of gamification

Gamification has been used in various contexts; a survey by Seaborn and Fels (2015) conducted to determine the current state of the field shows that the most popular areas of application for gamification for the purposes of research are education, health and wellness and online

communities (Seaborn & Fels 2015:27). There are also a number of examples of the use of gamification outside the sphere of research, for example *Habitica* (https://habitica.com/), a productivity application and *Zombies, Run!*, a running application.

The main purpose of gamified systems in all domains is the motivation of the user towards a desired end (Deterding 2014:315; Seaborn & Fels 2015:14). In a business or service context they are used to encourage the engagement of users with the desired system or product, as well as to improve the quality and productivity of user or employee actions (Hamari, Koivisto & Sarsa 2014). In education these systems are used to improve the motivation of students in order to improve learning, engagement and achievement (Banfield & Wilkerson 2014:291; Ibanez, Di-Serio & Delgado-Kloos 2014:291; Schreuders & Butterfield 2016)

These systems promote positive responses because they improve the experience for the user (Decker & Lawley 2013:233). It has been observed that people are willing to play games without the promise of extrinsic rewards. The assumption is therefore that the use of elements of games in other contexts will result in users engaging with the content of those systems without requiring any external motivation (Deterding et al. 2011:10; Knaving, Björk & Nacke 2013).

2.3.5 Gameful design

As described briefly in section 2.3.2.1, gamefulness is a term that can be used to describe the experiential qualities of games. Gameful design then would be the process of designing a system in order to afford this quality of gamefulness. This is typically done using game design elements (Deterding et al. 2011:11). Mentioning the use of game design elements echoes the definition of gamification provided in section 2.3.2 which leads to a need to explore the difference between gameful design and gamification.

Gamification has been defined as the use of game elements in non-game contexts, but gameful designed can be described as the "end of affording *ludic* qualities or gamefulness in non-game contexts" (Deterding 2015:297). The difference between these two terms is the fact that gamification describes a design strategy (the use of game elements) while gameful design describes a goal (affording gamefulness) (Deterding et al. 2011:11). These terms are interlinked in that they describe different properties of the same phenomenon. The term "gameful" was originally used in the sixteenth century to refer to the time of a person's life when they played many games (McGonigal 2014:656). McGonigal (2011:27) redefined the term to mean "having the positive traits of a gamer" or "having the positive traits of a game" (McGonigal 2014:656).

The term is now being used to describe systems which are designed to work and feel like a game (McGonigal 2014:655).

The following sections will first consider what these *ludic*, or game-like qualities are and how they are created in games. Then they will explore how these qualities can be designed for in order to create effective gameful systems. Finally, they will address the criticism levelled at gamification by differentiating clearly between gamification and gameful design and showing that the latter is able to not only overcome the problems raised by the critics, but lead to well-designed systems that enable human flourishing.

2.3.5.1 Ludic qualities

There is a lack of consensus in the literature about how to describe the experiences evoked by games (Boyle et al. 2012:778). In the context of the motivational power of video games, Rigby and Ryan (2011:8) explain that describing game experiences as "fun" leads to problems because there is very little research to support the meaning of "fun" in games. The reason not to base game experiences on fun is two-fold: firstly, the word is used in a wide variety of contexts in addition to games and secondly, it does not seem to be an accurate description of the power of games when one considers how much time and effort players invest in them. Instead, Rigby and Ryan (2011:8) recommend shifting from speaking about games in terms of their ability to afford fun experiences to understanding their ability to fulfil the three basic human needs of competence, autonomy and relatedness (Rigby & Ryan 2011:9). Their model, the Player Experience of Need Satisfaction (PENS) model (Ryan, Rigby & Przybylski 2006; Przybylski, Rigby & Ryan 2010; Rigby & Ryan 2011) does exactly this.

Deterding (2015:298) argues that many frameworks which attempt to describe game experiences have a number of issues. These issues to include a lack of focus on the internal and motivational processes that give rise to enjoyable experiences and the game structures that afford these processes. Deterding describes the PENS model as one framework that avoids these issues.

The model is based on self-determination theory (section 2.1.1) and specifically the sub-theory of cognitive evaluation theory (CET) (section 2.1.1.2.1) which has been used for more than three decades to guide research on intrinsic motivation in sports and leisure activities (Przybylski, Rigby & Ryan 2010:155). CET is concerned with the factors that influence a person's intrinsic motivation and it proposes that conditions or events which increase their sense of autonomy and competence, and to a lesser degree relatedness, will support their intrinsic motivation for an activity (Ryan & Deci 2000b:70; Ryan, Rigby & Przybylski 2006:349). Intrinsic motivation is

motivation based on the inherent satisfaction provided by an activity, as opposed to motivation based on some external reward or punishment, which is considered extrinsic (Ryan & Deci 2000a:56). Ryan et al. (2006:349) suggest that people play games because they are "intrinsically satisfying" and this satisfaction is based on the experiences provided by the games (Przybylski, Rigby & Ryan 2010:155). The empirical tests of the PENS model have shown that games whose features satisfy the three psychological needs will enhance the player's motivation to play (Ryan, Rigby & Przybylski 2006:361) and thereby enhance their intrinsic motivation (Przybylski, Rigby & Ryan 2010:157).

2.3.5.1.1 Challenges

This ability of games to satisfy the three psychological needs of competence, autonomy and relatedness is grounded in their nature – specifically the fact that they inherently include challenges, as discussed in section 2.2.2. Challenges and conflict are core components of a game (Salen & Zimmerman 2003:80; Fullerton 2008:76–78; Schell 2008:209).

Challenges are able to result in motivating and enjoyable experiences by satisfying each of the three basic needs in the following ways: firstly, competence, the need to feel a sense of efficacy and capability (Deci & Ryan 2002:7), is satisfied as game challenges are most often designed to increase slowly with the player's progress (Przybylski, Rigby & Ryan 2010:155). This means that the player will not be overwhelmed by the difficulty of the challenge and become frustrated, nor will the challenge be too easy and the player become bored. This relates very closely to flow theory (section 2.1.2). Feedback is also an important ingredient here. The player should always be made aware of their progress so that their feelings of competence can be reinforced (Rigby & Ryan 2011:19).

Secondly, the autonomy need of the player is satisfied as they are allowed to choose which challenge to undertake and which strategy to use when doing so (Rigby & Ryan 2011:44). Games often create a sense of "equifinality" which refers to the fact that there are multiple routes to an end (Przybylski, Rigby & Ryan 2010:156). This also gives the player a lot more freedom of choice.

Lastly, challenges in a multiplayer game allow players to work together to overcome them or in a single player game, a player can complete a challenge in the service of a significant virtual character (Przybylski, Rigby & Ryan 2010:156; Rigby & Ryan 2011:71; Deterding 2015:299). This leads to the third need of relatedness being satisfied. Rigby and Ryan (2011:68) explain that this satisfies the relatedness need because it makes the player feel like they matter and are viewed as significant.

It becomes clear that challenges are a core component of gameplay and they are able to satisfy the three basic psychological needs and thus result in motivating and enjoyable experiences for the player. The next section will examine how these experiences can be designed for.

2.3.5.1.2 The experiences of games

The motivating and enjoyable experiences provided by games are one of the reasons why games exist in the first place. "The game is not the experience. The game enables the experience, but it is not the experience" (Schell 2008:12). Schell (2008:10) explains that these experiences are what the game designer cares about. The MDA model by Hunicke, LeBlanc and Zubek (2004) illustrates this point well by explaining how the concepts of mechanics, dynamics and aesthetics relate to each other. The mechanics are the individual components of the game which give rise to dynamics when they act upon each other and the inputs of the player at runtime and this gives rise to the emotional response or the experience of the player.

Challenges can be considered dynamics because they are created by the system as a combination of mechanics and only result in gameplay and experiences when they are acted upon by the player. In order for a game to evoke the experiences in a player that are desired by the game designer, its mechanics need to be properly balanced (Hunicke, LeBlanc & Zubek 2004; Schell 2008:207; Egenfeldt-Nielsen, Smith & Tosca 2009:103). In order to achieve this balanced state, a game designer must move through multiple iterations of each mechanic. This is described as "tuning" (Hunicke, LeBlanc & Zubek 2004) or "playcentric design" (Fullerton 2008:10). It relates to the concept of iterative design in the field of interaction design which is a well-established method of ensuring that interfaces are usable and effective (Gould & Lewis 1985:300; Mao et al. 2005:108; Rogers, Sharp & Preece 2015:327). Iterative design is described as the process of prototyping and testing until all problems are found and solved (Gould & Lewis 1985:300). In terms of designing for game experiences, Deterding (2015:300) calls this "iterative experiential prototyping" and describes it as a process of defining the desired experiences and then ideating and testing the mechanics until they give rise to the chosen experiences.

The reason why it is necessary to implement iterative experiential prototyping is that these experiences are emergent from the interactions between the player and the system and therefore cannot be reliably predicted without testing (Deterding 2015:300). They can be referred to as systemic, emergent qualities of games (Deterding 2015:299) in that they relate to the system as a whole and emerge from the player's interaction with it. The paradigm which stands in contrast to this is illustrated by edutainment games. These games viewed learning as an activity which is inherently uninteresting and sought to make it better by adding games. The result was what can

be called the "chocolate-dipped broccoli" paradigm (Bruckman 1999:75). Assuming that something fun can simply be applied to something else less interesting does not necessarily result in a good, enjoyable product. Deterding (2015:300) describes this as an inherent-additive paradigm.

2.3.5.2 Combining game design and interaction design

The previous two sections have dealt with how games are able to give rise to enjoyable and motivating experiences and how game designers can create games that afford these experiences. Since it has been established that gameful systems are not full games, it is necessary to explore the methods of combining the lessons learnt from games with those learnt from interaction design.

From the definition of gameful systems provided by Deterding (systems which afford affording *ludic* qualities or gamefulness in non-game contexts), it is possible to conclude that gameful systems have two main purposes: firstly, they should serve a specific function in the non-game context in which they are situated. Secondly, they should serve the above-mentioned function through motivating and enjoyable experiences characteristic of games.

The field of interaction design is concerned with designing products to support peoples' activities (Rogers, Sharp & Preece 2015:9). With regards to user experience, it is concerned with designing for a specific user experience, not designing the experience itself (Rogers, Sharp & Preece 2015:14). In contrast, game design focuses on designing the experience by first defining the experience and then creating the design that gives rise to it.

A problem that arises when combining these two fields is the fact that concepts from the area of game design cannot simply be directly applied in interaction design. This is because they do not always make sense out of context. An example is speaking about the game design pattern "Resources" (Björk & Holopainen 2006:427–428), described as "representations of commodities that may be used to fund actions in the game". In the context of a word productivity application, speaking about resources in the same way would make no sense. This is because patterns are usually domain- and system-bound (Deterding 2014:313) which means that the resource pattern, when taken out of the context of game design, is no longer applicable.

Therefore, in order to allow interaction designers to create gamified systems without the help of game designers, there is a need for the elements of game design to be translated into a format understandable by practitioners outside the field (Deterding 2015:302).

A second major difference between these two fields is that of challenges. The purpose of interaction design is to optimize systems so that they are as easy to use as possible (Rogers, Sharp & Preece 2015:19). Naturally, this would then involve removing all challenges that stand between the user and the system. On the other hand, the main focus of game design is crafting challenges that result in motivating experiences. It becomes clear that there is a need to reconcile these differences if one wishes to design gameful systems.

The solution to this problem should be the same as that used by serious games – intrinsic integration (Kafai et al. 1998:160). This is the opposite of the technique employed by early edutainment games which is called extrinsic integration. In extrinsic integration, the learning content is unrelated to the game's objective. For example, if a game is about learning mathematical fractions, then the student might be playing a game about building a house and occasionally be asked questions about fractions. When intrinsic integration is used, the main learning content is an inherent part of the game world and objective (Kafai et al. 1998:160). This concept is first introduced by Malone (1981:360–361) as intrinsic or extrinsic fantasy, the former being a game where the fantasy and the skill depend upon each other, while the latter being a game where the fantasy depends on the skill but not vice versa. This concept is echoed in the work of Rieber (1996), who translates it to endogenous and exogenous fantasy, and Squire (2006:25) who refers to endogenous and exogenous games. By intertwining the learning material with the context of the game, the player must engage with the content in order to overcome the core challenges of the game (Deterding 2015:304).

This process of intrinsic integration can be applied to gameful design, although in a slightly different way. The designer will need to identify the challenges that a user inherently faces as they attempt to pursue their needs through the system. These challenges should then be modified to produce motivating and enjoyable experiences (Deterding 2015:304). However, it is important to ensure that the challenges identified are inherent to the activities of the user, otherwise the designer will simply be adding additional unnecessary challenges to the system without the resulting gameful experiences (Deterding 2015:304).

2.3.5.3 Requirements for gameful design

Based on an understanding of the motivating and enjoyable characteristics of games and the possible ways in which these can be transferred to the field of interaction design, it is now possible to provide the six requirements for gameful design as defined by Deterding (2015:305).

1. **Design for basic need satisfaction:** gameful design should aim to design systems which satisfy the three basic needs of autonomy, competence and relatedness in order to create enjoyable and motivating experiences.
2. **Design around inherent skill-based challenges:** turn the user's existing challenges in the activity into motivating experiences, rather than adding new challenges.
3. **Design for systemic emergence:** enjoyment and motivation are systemic, emergent properties. Avoid using the inherent-additive approach.
4. **Formative research:** since gameful design needs to support a user in their existing goals, research is required to establish these goals and needs.
5. **Design synthesis:** the results from the formative research must be used to inform the creation of ideas for gameful design.
6. **Epistemic mobilisation:** objects from the field of game design have to be translated into a form that can be used in the field of interaction design.

2.3.5.4 Criticism towards gamification

The primary reason for the criticism towards gamification is due to numerous implementations that attempt to achieve the same psychological results as fully-fledged games by using the simplest and least essential parts of games (Ferrara 2013:291; Bogost 2015:76). The main proponent of the criticism is academic and game designer Ian Bogost, who maintains that the field should be renamed to "exploitationware" (Bogost 2015:72) because of the way it takes advantage of people so that businesses can make more money. Bogost views current implementations of gamification as being "gamification without games" because they remove games from the situation by extracting all their value without being interested in the possibilities and potential of these games (Bogost 2015:68, 72).

The most common thread in the criticism towards this field is the fact that gamification misunderstands what makes games fun (Songer & Miyata 2014:206). This is what Robertson (2010:4) means when she says that gamification is the "process of taking the thing that is least essential to games and representing it as the core of the experience". This is because most implementations of gamification use some combination of points, badges and leaderboards (Hamari, Koivisto & Sarsa 2014:3027), which as Robertson (2010:4) rightly says, are not the core components of games. As Koster (2004:50) puts it, "A reward structure alone does not a game make".

Deterding (2014:306) echoes this sentiment when he says that the field is currently filled with shallow implementations because designers do not try to understand the psychology of game

enjoyment. An example to illustrate this point is the use of a gamified system by Disneyland hotels (Deterding 2014:308). The system showed the working speeds of laundry workers on large screens in the basements floors of the hotels. It was expected that this would create a fun competition for the workers, but instead they said that it made them feel controlled by their management. A game design principle that was missed in the design of the system is that playing games is a voluntary activity. In the implementation, workers had no choice in their participation in the system, which led to them feeling controlled by it instead of motivated. This may have contributed to the lack of success of the system as a whole.

Deterding (2014:306) argues that the most important thing that should be done now is to rescue gamification from the gamifiers. The next section will address this concern by exploring how gameful design can be used to solve the problems mentioned above.

2.3.5.5 Gameful design as a solution

Section 0 has shown that games are able to satisfy the three basic psychological needs and in doing so, elicit intrinsic motivation. Furthermore, the sections following it have shown that it is possible to design non-game systems that can also afford these experiences as the user engages with the challenges they provide.

The previous section showed that many gamification implementations are shallow and usually only incorporate some combination of points, badges and leaderboards as a "game layer" on top of the existing system. This is suggestive of the inherent-additive approach discussed earlier (section 0). Designers tend to add game elements to a system and expecting the resulting experiences to be gameful, but they miss the fact that these gameful experiences are the result of iterative experiential prototyping because they are emergent systemic properties.

The underlying problem with these implementations is the fact that designers view them as simply designing a system, forgetting about the context of use and more importantly, the people who will be using them. There is a strong need to rethink the scope of gamification (Deterding 2014:307) and to move from "content to context" (Squire 2006:19). This requires a move from simple system design to socio-technical system design (Trist 1981:11; Deterding 2014:313). This is an approach that considers both social (human) and technical factors in the creation of a system and it is an important perspective that ensures that systems meet their intended goals (Baxter & Sommerville 2011:4).

In addition, instead of focusing on using game elements, designers should aim to design for experiences. There are two reasons for this: firstly, game concepts cannot directly be transferred

to the domain of interaction design (see section 0) and secondly, the best way to create an intrinsically motivating system is to design for motivating experiences that satisfy the three basic needs (see section 0).

It can therefore be summarised that gameful design is a holistic and socio-technical approach to the practice of designing non-game systems with game elements. It addresses the main criticisms aimed at the field - that of dishonouring games and using their least important elements - by focusing specifically on the experiences that they afford instead of their compositional elements. In doing so, it can be argued that gameful design treats games with great respect by understanding that the desired experiences are not simply elicited, but are the result of much testing and prototyping. In summary, gameful design done properly can be a type of "positive design" (Desmet & Pohlmeyer 2013) which ultimately results in human flourishing.

2.4 Education

The non-game context on which the gamification of this dissertation focuses is that of tertiary education. This section will introduce the concept of learning, followed by the primary theories of learning that form the basis of work in the field. Then the concept of motivation in education will be discussed. Finally, this section will close with a look at existing implementations of gamification in education and how this area can be improved using gameful design.

2.4.1 Defining learning

There is no singular, agreed-upon definition of learning due to the large number of different theories on the subject (Shuell 1986:413; Schunk 2011:3). In general, most definitions include the following three criteria as outlined by Shuell (1986:412) and Schunk (2011:4):

1. **Learning involves change:** in behaviour or the capacity to do something.
2. **This change is enduring:** this aspect is required in order to exclude temporary changes in behaviour that might be caused by drugs or fatigue. It is noted that forgetting does occur and therefore the change may not last forever.
3. **This change is as a result of practice or experience**.

The definition of learning provided by Schunk (2011:3) is therefore applicable: "Learning is an enduring change in behaviour, on in the capacity to behave in a given fashion, which results from practice or other forms of experience".

2.4.2 Theories of learning

In the field of education and learning, there are two broad categories of theories: behavioural and cognitive (Shuell 1986:413; Schunk 2011:21–22). Behavioural theories view learning as a change in the rate or type of response to a stimulus. These theories do not consider the mental processes that take place whilst learning occurs (Schunk 2011:21). Cognitive theories developed out of a need to understand the cognitive processes behind learning (Ertmer & Newby 1993:50). They are concerned with the brain processes, memory and cognition (Whitton 2014:28). Both cognitivism and behaviourism acknowledge the role of the environment in facilitating learning, but cognitivism views the learner as an active participant because it is their mental process that affects their response to the environment (Ertmer & Newby 1993:51). It also differs from behaviourism in that it views learning as changes in knowledge states rather than changes in responses to stimuli (Ertmer & Newby 1993:51).

2.4.2.1 Behaviourism

Behaviourism is a theory of human behaviour which is based solely on observation (Pritchard 2009:5). It does not deny the existence of mental processes, but it deems them unobservable and therefore they are discounted (Pritchard 2009:5; Schunk 2011:72). The primary idea on which behaviourism is based is the concept of a reaction made in response to a stimulus. This concept became well-known through the experiments conducted by Ivan Pavlov in which he induced the reaction of salivation in a dog in response to the stimulus of a bell (Pritchard 2009:6). The experiments showed that a natural response could be modified or reinforced through the use of a stimulus – thus a response could be conditioned.

A well-known behaviourism theory is operant conditioning. It involves the reinforcement of a behaviour through rewards (Schunk 2011:7). This theory was made famous by the psychologist B.F. Skinner. It is called operant conditioning to indicate that the response operates directly on the environment as opposed to being a reflex which has evolved naturally (Skinner 1963:504).

Behaviourism theories can be applied in teaching situations where it is necessary to teach students appropriate classroom behaviours or content that relies on rote learning such as tables or spelling (Pritchard 2009:9–10, 16). There are important considerations for using rewards in a learning situation as they can affect the motivation of the student. The effects of rewards on motivation are detailed in section 2.1.1.2.1.1.

Behaviourism then, views learning as the “acquisition of new behaviour” and as a fairly permanent process (Pritchard 2009:6, 15). It does not consider mental activity or the process of

understanding (Pritchard 2009:9; Schunk 2011:115). For this reason, it is also necessary to consider the theory of constructivism.

2.4.2.2 Constructivism

Constructivism is a term applied to a group of perspectives on learning that view it as the result of "mental construction" (Pritchard 2009:17). The primary idea is that people develop their own knowledge by adding to what they already know (Pritchard 2009:17; Schunk 2011:231).

Important perspectives in the field of constructivism include the work of Jean Piaget on the concepts of assimilation and accommodation (Piaget 1954:350); Vygotsky's work on how people learn by interacting with others (Vygotsky 1978:84) and metacognition (Pritchard 2009:27).

Three concepts of constructivism which are particularly relevant to an understanding of gameful design in education are schema, situated cognition and scaffolding.

2.4.2.2.1 Schema

Mental models are a representation of an individual's view of the world. "Human beings understand the world by constructing working models of it in their minds." (Johnson-Laird 1983:10). These models are simpler than the realities they represent, they are incomplete and constantly evolving (Johnson-Laird 1983:10; Pritchard 2009:22). They are the basis of schema theory (Pritchard 2009:21).

Schemas are the representation of the manner in which knowledge is stored in the mind of a person (McVee, Dunsmore & Gavelek 2005:537). A schema can be viewed as a framework that consists of nodes, which represent ideas of pieces of information, and connections between them. Any connections between nodes represent meaningful links between items of knowledge. The connections between nodes differ for each individual, which explains why people have different understandings about the same topic (Pritchard 2009:21). The more connections there are within a schema, the more understanding the individual is said to have (Pritchard 2009:21). When new knowledge is assimilated and accommodated, it is included in the schema which will then expand and become more complex. "Unless schemata are changed, learning will not occur" (Fry, Ketteridge & Marshal 2008:10).

Schema theory and the work of Piaget underscore the importance of prior knowledge in constructivist learning. It also shows that students do not approach education without prior knowledge and ideas (Bransford et al. 2000:10).

2.4.2.2.2 Situated cognition

The concept of situated cognition is also important in constructivism. It maintains that learning takes place within a physical and social context and not solely within the mind of the individual (Schunk 2011:233). Since knowledge and actions are a result of the environment, "the context and content of thought are hence inseparable from the reasoning process" (Hennessy 1993:2).

This concept is important because it means that if learning takes place in a context outside the understanding of the learner, then it might not be successful. It also implies that understanding gained in one context is not necessarily transferable to another context (Pritchard 2009:26). In order to solve these problems, it is necessary to create authentic learning tasks (Herrington & Herrington 2006:vii; Lombardi 2007:2; Pritchard 2009:26). Selinger (2001:96) explains that authentic tasks are those which pupils can relate to their experience inside and outside school and are tasks which professional practitioners in the field would do. These kinds of tasks have been proven to improve learning and motivation and lead to deeper levels of engagement (Selinger 2001:96; Pritchard 2009:26). Authentic tasks allow learning to span across contexts, which is what Lombardi (2007:3) describes as "portable skills".

2.4.2.2.3 Scaffolding

The concept of scaffolding is also important in constructivism. Wood, Bruner and Ross (1976:90) describe it as "the process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts. This scaffolding consists essentially of the adult 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence". Scaffolding then, can be viewed as support provided by another person to the learner which enables them to gain new understanding without being overwhelmed by concepts that they have not yet mastered.

2.4.2.2.4 Summary of constructivism

Constructivism is summarised as the construction of knowledge and it is considered a process which requires the active participation of the learner. The following points summarise the discussion succinctly (Lewis & Wray 2005:19–21; Pritchard 2009:32–33):

- Learning occurs when schemata are changed and updated. There is an emphasis on prior knowledge in this process.
- Learning is a social process.
- Learning takes place within a context and therefore authentic tasks are important.
- Learning is a metacognitive and an active process.

2.4.3 Motivation in education

Motivation is an essential part of learning because it helps students to engage in activities that will ultimately lead to them learning something (Schunk 2011:346). Intrinsic motivation has large implications in the field of education (Deci et al. 1991:325–326; Schunk 2011:386).

Unfortunately, modern education often has a very narrow set of goals on which it focuses which leads to teachers resorting to grades, tests and other external pressures to ensure that students meet these goals. Instead of fostering intrinsic motivation, this leads to controlled environments which do not meet the three needs properly (Ryan & Deci 2017:353).

Intrinsic motivation is part of self-determination theory. For this reason, the implications of self-determination theory in education will be discussed below, with an overarching aim to determine how best to facilitate intrinsic motivation in educational settings.

2.4.3.1.1 Intrinsic motivation

Intrinsic motivation is a natural instinct and most childhood learning is intrinsically motivated (Ryan & Deci 2017:351–352). The problem, as mentioned above, is the structure of modern education systems.

Studies show that intrinsic motivation leads to greater conceptual understanding as opposed to rote memory (Benware & Deci 1984:763) and it promotes an increase in the flexibility of the student's way of thinking (Deci et al. 1991:326; Reeve 2009:113). These two concepts – conceptual understanding and flexible use of knowledge – can be considered defining characteristics of optimal learning (Deci et al. 1991:326). Additional benefits of intrinsic motivation include persistence, creativity and subjective well-being (Reeve 2009:112).

Ryan and Deci (2017:354) describe the learning benefits of intrinsic motivation by explaining that "we see the highest quality learning and achievement occurring when students' interests and engagement in learning are supported, rather than when educators rely on extrinsic incentives and controls to pressure students toward a narrow set of preordained outcomes".

2.4.3.1.2 Self-determination theory (SDT) and the facilitation of intrinsic motivation

SDT has been thoroughly explored in section 2.1.1. It is primarily concerned with the social and environmental factors which undermine and facilitate intrinsic motivation. This section will examine the specific ways in which it can be used in education.

2.4.3.1.2.1 Cognitive evaluation theory

SDT posits that the innate needs to autonomy, competence and relatedness must be fulfilled in order to facilitate intrinsic motivation. Cognitive evaluation theory (CET) (section 2.1.1.2.1) can be used to understand how this works in education.

The first proposition in CET (section 2.1.1.2.1.1) relates to the environment of the learner and their autonomy. If the environment is considered controlling, then the perceived locus of causality (PLOC) of the person will become external. Intrinsic motivation results out of an internal PLOC which means that it stems from the self, rather than from the environment (Niemiec & Ryan 2009:135). Some educational environments tend to have strict rules in place accompanied by close observation (Niemiec & Ryan 2009:134). These controlling conditions result in a lack of autonomy in students which in turn causes them to work and learn from an external PLOC thus lowering their intrinsic motivation (Deci et al. 1991:337). De Charms and Shea (1976) describe this situation by saying that learners can either be "origins" (active, with an internal PLOC) or "pawns" (passive, with an external PLOC). Instructors who acknowledge their students' points of view and choice tend to facilitate more intrinsic motivation in the students (Ryan & Deci 2017:356)

The second proposition in CET relates to competence (section 2.1.1.2.1.1). An environmental event has the ability to raise or lower a person's competence (Ryan 1982:451). In a classroom situation, this event can be as simple as feedback on an activity. If a student is doing well and is given feedback to prove this, they are likely to feel competent in the activity. Hanna et al. (2010:96) describe this as one of the key principles of student motivation: "Students are more motivated when they feel confident to do what is expected of them". Positive feedback to enhance competence only has the ability to increase intrinsic motivation; however, if it is accompanied by a sense of autonomy (Deci & Ryan 2002:11). This means that positive feedback given within a controlling environment will not improve intrinsic motivation.

Lastly, the third proposition of CET (section 2.1.1.2.1.1) relates to the type of environmental event. Events have three aspects – informational, controlling and amotivating – and the aspect which is most prominent will determine the effect of the event on the intrinsic motivation of the

student. A controlling event is something which causes the student to feel pressure to obtain a certain outcome or attempts to coerce a person into doing something (Ryan 1982:451). Deadlines, surveillance and threats fall into this category (Deci & Ryan 2002:12). If a student is subjected to pressure to obtain a specific outcome then this controlling pressure will harm intrinsic motivation (Flink, Boggiano & Barrett 1990:916). An informational event does not apply pressure but does provide relevant information of some sort. Verbal praise from a teacher is considered informational while negative feedback results in a decrease in competence. Tangible rewards tend to decrease intrinsic motivation because they change the PLOC to external.

2.4.3.1.2.2 Organismic integration theory (OIT)

OIT shows the importance of relatedness in the internalisation of externally regulated behaviours. Relatedness is the basic need to feel connected to others. In an educational setting, this means that students who feel connected to their teachers have higher levels of relatedness which leads to positive behavioural and academic outcomes (Kaufman & Dodge 2009:102, 104). The work Kaufman and Dodge (2009) shows that autonomy and mastery goals are two factors which influence relatedness.

Mastery goals form part of a broader categorisation called achievement goals which refers to the purpose of an individual's engagement in an activity (Elliot & Church 1997:218). Mastery goals (also known as learning goals (Schunk 2011:376)) "correspond to a desire to learn" (Darnon et al. 2009:119) and cause students to focus on strategies to improve their skills (Schunk 2011:376). Mastery goals have been linked to positive outcomes such as task interest, deep studying and effort (Darnon et al. 2009:119). There are links between mastery goals and intrinsic motivation (Heyman & Dweck 1992), but some authors caution that mastery goals should be accompanied by autonomy in order to foster intrinsic motivation (Benita, Roth & Deci 2014:265).

The concept of facilitating autonomy has been explored previously (section **Error! Reference source not found.**). Ames (1992:267) recommends various strategies for creating an environment that facilitates mastery goals in students. The recommendations pertain to the tasks given, the authority of the teacher and the method of evaluation:

Task:

- Focus on the meaningful aspects of learning activities.
- Design tasks for novelty, variety and student interest.
- Design tasks that offer a reasonable challenge to students.
- Support development and use of effective learning strategies.

Authority:

- Focus on helping the students participate in the decision making.
- Give opportunities to develop responsibility and independence.
- Support development and use of self-management and monitoring skills.

Evaluation:

- Focus on individual improvement, progress and mastery.
- Make evaluation private, not public.
- Recognise students' efforts.
- Encourage the view of mistakes as part of the learning process.
- Provide opportunities for improvement.

Schunk (2011:379) summarises this succinctly: "learning situations that emphasize self-improvement, discovery of new information and usefulness of learning material can promote a learning-goal orientation". In addition, he emphasises that competitive environments and tests of intellectual skill can have the opposite effect, fostering performance goals which are more concerned with completing tasks than the process of doing so (Schunk 2011:376,379).

2.4.3.1.2.3 Summary of self-determination theory in education

The previous two sections have shown that it is possible and necessary to satisfy the three needs in educational settings. Autonomy is negatively affected by a controlling environment and positively affected when students feel like they have some measure of control in the situation. Competence depends on the manner in which feedback is provided. Both of these needs are negatively affected by tangible rewards. Lastly, relatedness can be fostered through autonomy and mastery goals which prioritise the process of learning over the result.

2.4.4 Gamification in education

Gamification has been implemented in a number of contexts, but literature reviews on the topic tend to agree that education is the most common field in which it has been used (Hamari, Koivisto & Sarsa 2014:3028; Seaborn & Fels 2015:27). The most probable reason why a gamification approach is a popular choice for education is due to the need for structures that will improve the motivation of students since this is an ongoing challenge to educators at all levels (Glover 2013:1999; Dichev et al. 2014:80; Van Roy & Zaman 2017:18). In addition to being good intrinsic motivators, games that are well designed contain many components that are also effective in education, such as opportunities to practice (Gee 2003:68), detailed feedback on progress (Ramirez & Squire 2015:635) and the freedom to fail (Stott & Neustaedter 2013:1).

Of the existing studies which have implemented gamification in classrooms and university courses, many have focused on simply adding game elements to the course (see section 0 for a detailed review). At a glance, this seems appropriate according to what gamification is, but based on the discussion of gameful design in section 00, simply adding game elements does not necessarily result in the desired gameful experiences or the desired motivating effects afforded by games. These elements are often not directly transferable to another domain and require significant effort from the educator in order to have a lasting positive effect (Ramirez & Squire 2015:629). The proof of this widespread belief that adding points, badges and leaderboards to a system will result in increased engagement and motivation is evident in literature reviews on the topic (Hamari, Koivisto & Sarsa 2014:3027) which outline the most used elements; theoretical studies on the effects of individual elements (Richter, Raban & Rafaeli 2014:36) and most commonly, empirical implementations testing the effects of various elements (de Santana et al. 2016). The following review of existing educational implementations will also support this point. The current understanding of gamification seems to be mostly limited to adding game elements as a layer on top of existing educational content.

2.4.4.1 Tertiary education implementations

This section will examine implementations of gamification at a tertiary level. The studies covered in this section were selected through a search using the keywords “gamification AND education” and “gamification AND university”. Additionally, literature surveys on gamification by Seaborn and Fels (2015) and Nah et al. (2014) were examined for studies.

The following criteria were used to select the studies:

1. The study must be published between 2011 and 2017. According to Deterding et al. (2011), gamification became widespread in the second half of 2010, therefore the first major studies in the area would likely be published from 2011 onwards. The upper limit is 2017 because studies from 2018 would still be largely unpublished.
2. The study must have been implemented at a tertiary-level institution as that is the scope of the current study.
3. The study must include an explanation of how the gamification was implemented, detail about the sample group used as well as adequate empirical data to allow it to be compared to other studies.
4. The goal of the study must include improving learning, engagement, motivation or some similar objective. This excludes studies done at universities to allow the students to become familiar with the campus or to foster communication among students in a course group.

2.4.4.1.1 McDaniel, Lindgren & Friskics (2012)

McDaniel et al. (2012) present a study in which badges and a leaderboard were implemented in an online digital media course. The course contained an overarching narrative combined with achievements in the form of badges. Results from the survey showed that students enjoyed the narrative component, but only felt mildly positive about the achievement system. The authors posit that this might be due to the frustration caused by the fact that a portion of the students' grade was based on the number of achievements they collected. This frustration could have been increased by the inclusion of hidden achievements in the system. With regards to the leaderboard, some students reported being motivated to attain achievements when they saw that their friends had received them.

2.4.4.1.2 Barata, Gama, Jorge, et al. (2013a), Barata, Gama, Jorge, et al. (2013b) and Barata, Gama, Fonseca, et al. (2013)

The aim of this study was to test the effectiveness of gamification in a Masters course for multimedia content production. The study shows a comparison of two semesters, the second of which included experience points (XP), levelling, leaderboards, challenges and badges. These elements formed part of the structure of the course, effectively replacing existing grading structures. For example, instead of gaining marks for evaluation activities, students were awarded XP. Since the addition of the game elements to the course, lecture attendance increased by 11% and the activity on the forum grew significantly. Students reported feeling more motivated and

said that although the course had a higher workload than others, they did not mind spending time on it because it was satisfying.

A follow-up study was done based on the same gamified course (Barata, Gama, Jorge, et al. 2013b). Feedback from students in the first study was taken into account and new achievements were added to the system to encourage group work and oral participation. New challenges were also added which increased the workload of the course. Data were analysed over five years – the final two being the gamified years. The results are somewhat contradictory to those of the first study. Class attendance in the second gamified year was not consistent with the first gamified year which led to the conclusion that the gamified approach did not affect attendance. In both years students were significantly more active on the forums. Feedback from students was similar for both years. There was not enough statistical evidence to support an increase in student grades, but the second gamified year had the highest minimum grade and the most students reaching the topmost grade. The results also suggest that students were more engaged in the years that were gamified. The study had some limitations including the fact that the student populations were different each year and the course topics changed over the years.

The previous two studies revealed that the students did not have enough autonomy and room to be creative. As a result, in the sixth year of the study, the gamified course was augmented with a virtual world in which students could explore, unlock new areas and create custom content (Barata, Gama, Fonseca, et al. 2013). Initially, the use of the system was high, but the students lost interest in the virtual world because it did not allow them to do anything other than developing custom content. On the other hand, the system did encourage the students to perform complex creative tasks.

2.4.4.1.3 Cheong, Cheong and Filippou (2013)

With the aim of gauging the impact of a gamified activity on student learning, engagement and enjoyment, a mobile quiz application was implemented among undergraduate information technology students. The application awarded points for questions answered and showed a leaderboard. Students felt that the system aided their learning and their ability to determine their current level of knowledge. The majority felt engaged in the activity. Feedback also showed that the leaderboard made them feel embarrassed if they did not do well enough.

2.4.4.1.4 Decker and Lawley (2013)

The *Just Press Play* project was used in the School of Interactive Games and Media at Rochester Institute of Technology. Its aim was to make the undergraduate experience easier for the students

by helping them to learn the skills that they would need to earn an undergraduate degree. It was a voluntary system that contained activities on an implemented website as well as some outside the website. These consisted of tasks that resulted in achievements as well as standalone achievements. A wide variety of achievements and tasks represented creative, cultural and technical skills. Although the pilot project had technical problems, it nevertheless had some positive results. An achievement rewarded for 90% of students passing a freshmen programming course resulted in students helping each other and organising study sessions, and ultimately, a higher pass rate. There was also an increased amount of interaction between faculty and students.

2.4.4.1.5 Denny (2013)

A badge system was implemented in *PeerWise*, a repository for student-generated multiple-choice questions. The purpose of the badges was to encourage student participation in the system. Half of the class (516 students) had badges added to their system while the other half was the control group. There was no difference in the number of questions authored between the two groups, but the group with badges answered significantly more questions with no reduction in quality. Most of the students reported enjoying the addition of the badges to the interface. The results show that some activities were more significantly impacted by the badges than others, but also that the activity was probably already motivating to the students regardless of the badges because the group without badges authored more than the required number of questions.

2.4.4.1.6 Domínguez et al. (2013)

In an attempt to improve student motivation towards completing optional exercises in an ICT qualification course, Domínguez et al. (2013) created a gamification plugin for the Blackboard e-learning platform on which the course was presented. Students could earn trophies for completing the optional tasks, collect achievements and compare their progress with others using a leaderboard. The results showed that the students in the experimental group did better on practical exercises but worse on written ones. The majority of students were more motivated by the traditional exercises as opposed to the gamified ones. Finally, there were mixed feelings about the leaderboard, with some students enjoying the competition and others averse to the fact that everyone else could see their progress.

This system was later used in a study which compared the effects of gamification and social networking on education (de-Marcos et al. 2014). The results were similar to the study discussed above. Both gamification and social networking had a positive effect on practical performance, but the same groups did worse in written exercises. Low participation rates were a problem in all the groups.

2.4.4.1.7 Goehle (2013)

This study added a gamification plugin to the *WeBWorK* online homework system in order to improve student engagement. The system included XP, levelling and achievements. There was no control group which made data comparisons impossible, but survey results and data from the system showed that students actively engaged with the system and tried to earn achievements. They enjoyed the achievement system because they felt that it provided positive reinforcement and gave them concrete goals to work towards during the semester.

2.4.4.1.8 Paisley (2013)

This study involved the inclusion of a leaderboard and experience points in a university course in order to motivate students to complete optional activities related to the course content. The first four weeks of the course were un-gamified while the following four weeks had the gamification elements added. A comparison of the survey results before and after the addition of the elements showed that the perceived motivation and engagement of the students increased significantly.

2.4.4.1.9 O'Donovan, Gain and Marais (2013)

A gamification implementation was used in a computer science games course at the University of Cape Town. The aim of the implementation was to encourage participation in the form of lecture attendance and class participation, to encourage creativity and problem-solving skills and motivate students to engage with the course content. The gamification elements included the use of XP as rewards for quizzes, puzzles, group challenges and lecture attendance. The XP was used to determine levels which could be reached as well as to reward students with in-game currency which could be spent in a virtual shop. Finally, progress bars and badges were also included. The results showed that students felt that the addition of the elements improved their understanding and their level of engagement, but the storyline and theme used did not strengthen the implementation. Class attendance and course marks were significantly higher than previous years, but there were some extraneous variables involved. The most popular elements were the leaderboard and the in-game currency which was predominantly used to purchase extensions on class assignments.

2.4.4.1.10 Banfield and Wilkerson (2014)

In order to improve the intrinsic motivation and self-efficacy of students in two undergraduate classes, some of the classes were supplemented with class exercises and a scoreboard at the front of the class. The scoreboard kept track of the students' progress and created competition among the students. The results showed that the intrinsic motivation and self-efficacy of the gamification group was significantly higher than that of the control group. A large percentage of

the control group was extrinsically motivated while very few of the gamification group was extrinsically motivated.

2.4.4.1.11 Ibanez, Di-Serio and Delgado-Kloos (2014)

A gamified learning platform called *Q-Learning-G* was added to undergraduate operating systems course at a university in Spain. The platform allowed students to improve their understanding of the C programming language by introducing and assessing questions relating to it. The system also had a leaderboard and awarded badges. Results showed that students continued participating in the system after they had acquired the maximum amount of credits allowed. Their reasons for this included wanting to earn all the badges and desiring to learn more about the C programming language.

2.4.4.1.12 Iosup and Epema (2014)

Gamification was applied to both an undergraduate and Masters level course in computer science at a technical university in the Netherlands. A variety of game elements were added to the two courses, including levels, badges and leaderboards. The results showed that students were motivated to think more carefully about the course and its design because of the gamification and some felt more motivated by the gamification. In addition, class participation and completion rates increased.

2.4.4.1.13 Hanus and Fox (2015)

This study was aimed at testing gamification elements which had theoretically been indicated to have negative effects on education. The elements tested were badges, leaderboards and incentive systems. Two communications courses were involved in the study – the one containing the game elements and the other not. The results showed that the leaderboard did not have a major effect on social comparison; the students in the gamified course had lower intrinsic motivation and class satisfaction scores but not lower levels of effort. They also had slightly lower levels of empowerment. Finally, their exam scores were lower and the results showed that the scores were affected by levels of intrinsic motivation. This study shows that game elements added to educational settings do not always have a positive effect. On the other hand, the authors do note that the gamified elements in the course were not optional for the students and this may have had a negative effect on intrinsic motivation.

2.4.4.1.14 Holman, Aguilar and Fishman (2013); Aguilar, Fishman and Holman (2013); Aguilar, Holman and Fishman (2015)

This study used gameful design to alter the method of assessment of two different undergraduate classes. It consisted of three individual studies, each outlined below.

The first study was implemented in a political theory course and it allowed students freedom to choose which assignments contributed to a part (60%) of their final grade and how these assignments would be weighted. This decision needed to be made by the students in the first six weeks of the course after exploring their interests and options. In addition, students were given three power-ups at the start of the semester which could be used to make up for class absences in order to improve their grade or to unlock additional assignments. Additional power-ups could be earned throughout the semester if students engaged in particular activities.

The third study extended the first study by adding a learning management system (LMS) called *GradeCraft* (https://umich.gradecraft.com) to the same course in the following semester. The *GradeCraft* system still allowed the students to choose which assignments made up 60% of their final grade as well as deciding how these assignments would be weighted using a point system included in the LMS (previously this weighting was managed manually by the instructor). Instead of power-ups, students were awarded badges that incentivized certain behaviours which could be spent to improve their grades (up to 25% of the final grade). Finally, the system included a section where students could predict their marks for assignments and view the effect on their final grade.

The results from both the first and the third study were similar. A survey showed that students' perceptions of the grading system were positively associated with how fair they thought the system was, how much control they felt they had over their grade and the extent to which they felt the system reduced the difficulty of attaining their desired grade. According to the study, this is evidence of autonomy and competence. With regards to course engagement, the students' opinions of the grading system were positively associated with working harder and doing more assignments.

The second study was an implementation of *GradeCraft* in a different undergraduate course, one focusing on video games and learning. This was the first course to include *GradeCraft*, which was designed based on the feedback from the first study. The results were similarly positive to those of the other two studies.

One additional finding that is of interest in this study is the fact that student's positive perceptions of the grading system and its ability to support autonomy, competence and engagement is unrelated to achievement goal beliefs. The authors conclude that this means their gameful course design is not affected by the type of incoming motivation of the student and has the ability to foster intrinsic motivation regardless of this.

2.4.4.1.15 Bajko et al. (2016)

Two different undergraduate courses were similarly gamified. Students earned XPs instead of grades, completed quests on their own as well as in groups called guilds, participated in quizzes and games of luck involving dice, and there was also a class leaderboard. Students reported enjoying the gamification of the courses and instructors observed that they tended to ask for more assignments in order to get ahead in the game. The students also said that they found the course content easier to understand, that it encouraged them to learn in different ways and to collaborate with their peers.

2.4.4.1.16 Schreuders and Butterfield (2016)

The assessment structure and tasks of a final year undergraduate computer security module were gamified in order to motivate students and to create a positive experience for them. Students could gain three kinds of experience points: skill XPs for completing applied tasks like lab work; knowledge XPs for completing research or multiple-choice questions and, wisdom XPs for completing reflective tasks such as writing short essays. Every activity besides attending lectures was defined in terms of quests and XP and XP had a direct impact on final grades. Students used a website to keep track of their earned XP. The study was run over two consecutive years. The results showed that the time spent on independent research, lab activities and work outside class increased. However, the statistical results on the effect of student motivation were inconclusive. The students from both years reported enjoying the gamified experience.

2.4.4.1.17 Song, Ping and Hao (2017)

The game element of points was used to encourage college students to ask questions during presentations in an Introduction to Computer Science course. Different experiments were conducted in which either the asker, the speaker or both received points when a question was asked. Results showed that students were asked more questions in all gamified experiments compared to the control. The gamification also motivated the shy students to ask questions when they would normally have kept quiet.

2.4.4.1.18 Summary of empirical studies

It is clear that the majority of the studies reviewed have used some variation of points, badges and leaderboards in their implementations. In the case of studies where these rewards have not resulted in external changes such as an increase in marks, they can still be considered intrinsic motivation (see the discussion in section 2.1.3.4). However, some studies (Aguilar, Fishman & Holman 2013; Schreuders & Butterfield 2016) did link their gamification elements to external rewards such as improved grades and reported positive results. Doing so causes the PLOC to shift to external and results in an undermining of intrinsic motivation. While results are still reported as positive, this is likely because the rewards are still being given; however according to cognitive evaluation theory, if the rewards are removed, the activity will probably stop. Additionally, the intrinsic motivation of the students has been harmed, which is a larger problem in the long-term.

A potential exception is the study done by Aguilar, Holman and Fishman (2015). The fact that they allow the students to choose which assignments to complete and how to weight these assignments promotes feelings of autonomy and competence, as reported. However, by requiring students to earn badges to improve their grades, the badges become tangible extrinsic rewards which then have the power to undermine the intrinsic motivation that may have been fostered by the autonomy and competence mentioned above. In conclusion, further research would have to be conducted to determine what the overall effect of the *GradeCraft* system is.

As a final note on the recurrent use of these game elements, Hanus and Fox (2015:152) motivate their choice by saying that these are the elements that are used in most classroom implementations. This suggests that some researchers are using these elements simply because prior studies have done so and reported good results. It also lends credibility to opinions of the gamification discontents by showing that current implementations attempt to take the easiest route to achieve the desired results as opposed to taking the "long view of gamification as a vehicle for sustained engagement" (Rigby 2015:117).

Another important concern is brought to light by a statement by de-Marcos et al. (2014:82): "Offering rewards is a kind of extrinsic motivation and this can be used to engage participants, but only as a tool towards promoting authentic intrinsic motivation in which the activity itself becomes the reward". The problem here is that the authors imply that the continuum on which extrinsic and intrinsic motivation are placed in organismic integration theory means that a person can be motivated enough to move from extrinsic to intrinsic motivation. This is disputed by Ryan and Deci (2017:197), "It is nonetheless important to recognize that when extrinsic

motivation is integrated, it is still not typically transformed into intrinsic motivation because it retains its instrumental nature". This means that although a person can be motivated to the point of internalised regulation, it still a different type of motivation to intrinsic motivation because the focus of the person will remain on future outcomes instead of the inherent pleasure of the activity itself. This is an important concept to clarify because it means that one cannot simply continue to reward a student extrinsically with hopes that they will develop an intrinsic motivation towards the activity.

In summary, some conclusions can be drawn from these studies. A large amount of research is being done in the area of gamification of education, but most of the implementations use some combination of basic game elements such as points, badges, leaderboards and experience points. There is little focus on the concept of gameful design in education, and even less so on the intersection of gameful design and motivation in education. This shows the need for a tertiary education study that focuses on the concept of gameful design in order to satisfy the three basic needs.

2.4.4.2 Improving educational gamification

The above review shows that there is a great need to change the focus of gamification in education. Specifically, implementations should be based on sound theories of motivation and game design in order to have lasting positive effects.

With regards to shifting the focus to motivation theories, there is a large body of empirical evidence to support the application of self-determination theory in education (see section 0). Rigby (2015:122) puts it this way, "…motivational energy is most conducive to gamification's desired outcomes – such as sustained engagement, positive psychological impact, increased value, and deeper learning – when gamification design and mechanics actively focus on facilitating and satisfying basic psychological needs, as opposed to simply seeking to capture attention or superficially amuse". In addition, there is a need to move away from a focus on adding game elements to a situation and towards gameful design, which requires rethinking the whole context to make it more game-like. The following sections will address areas in education where gameful design and SDT can contribute to better gamified applications.

2.4.4.2.1 Freedom to fail

Games allow players many chances to succeed while reducing the consequences of failure (Stott & Neustaedter 2013:1). This can take the form of multiple lives or the chance to reload at a checkpoint and try again. If applied to education, this principle will allow students to experiment

without fear of failure. This also focuses the attention on the process of learning instead of on the assessment of the task (Stott & Neustaedter 2013:1; Dichev et al. 2014:92). Freedom to fail would allow educators to encourage their learners to take risks in order to overcome their anxiety in certain learning areas (Ramirez & Squire 2015:637).

The idea of having the freedom to fail in a situation implies that there is something to fail *at*. This leads to goals and challenges. Challenges in gamified system are the main driving force behind feelings of competence. Stott and Neustaedter (2013:2) refer to this as progression and they prescribe scaffolding challenges in order to support the learner properly. This is the same concept of scaffolding from the learning paradigm of constructivism. If the challenges are scaffolded properly, as levels are in a game, the learner will be kept in the zone of proximal development (Vygotsky 1978:84). Gee (2003:70) refers to this as the Regime of Competence principle, "the learner gets ample opportunity to operate within, but at the outer edge of, his or her resources, so that at those points things are felt as challenging but not 'undoable'". This is also prescribed as a gamification heuristic by Roy and Zaman (2017:14).

Additionally, the tasks set for the learner should be authentic tasks (section 0) to ensure that the learning that takes place is deep and not dependent on the current context alone. This calls to mind the concept of intrinsic integration mentioned by Deterding (2015:303), "…overcoming the core challenge of the game requires and supports acquiring the concepts and skills to be learned. This makes pedagogical sense because gameplay embodies good, experientially grounded, explorative, scaffolded learning by doing".

If challenges and the freedom to fail concept are properly implemented in a gamified learning system then feelings of competence will be fostered in the learner.

2.4.4.2.2 Feedback

Feedback is important because it helps the learner to keep track of how well they are doing. This enhances competence (Ramirez & Squire 2015:636; Van Roy & Zaman 2017:14). While education already inherently includes feedback in the form of grades, in games it is usually very rapidly and continually provided. In a learning system, this will help the student to change their approach accordingly in order to achieve better results (Dichev et al. 2014:92). Using achievements, badges or some similar construct, it is possible to record the learning progress of the student (Ramirez & Squire 2015:635) and to show their growing mastery (Gee 2003:67).

2.4.4.2.3 Narrative

The use of narrative in education can be useful in creating a context that makes the learning concepts easier to understand because of the principle of situated learning (section 0) (Stott & Neustaedter 2013:3). Ramirez and Squire (2015:646) describe this as creating a deeper context for the learning activity.

2.4.4.2.4 Freedom to choose

Exploration of an environment or the ability to choose which activity to do can foster feelings of autonomy. Van Roy and Zaman (2017:13) recommend providing the student with a moderate amount of meaningful options so as to support their autonomy but not to overwhelm them with too many choices.

2.4.4.2.5 Social interaction

Allowing students to interact with their peers and with the educator will result in feelings of relatedness (Van Roy & Zaman 2017:15).

Many implementations of gamification will include a leaderboard in an attempt to generate healthy competition between students. For some students, this can be a strong motivator while for others, this can be embarrassing and demotivating (Sailer et al. 2013). The leaderboard has the potential to decrease intrinsic motivation if the context is perceived as controlling (Deci, Koestner & Ryan 2001:5–6). In addition, it can also be considered extrinsically motivating if it causes a person to interact simply to gain the top position.

2.4.4.2.6 Summary

This section on gamification in education has shown the current examples in this field are mostly surface level implementations which focus on some combination of points, badges and leaderboards. In the cases where these are extrinsically administered, it has been shown to foster extrinsic motivation.

The concepts of freedom to fail, challenges, feedback, narrative, freedom to choose and social interaction were introduced. These are means by which educational gamification can be implemented to focus on intrinsic motivation by facilitating the three basic needs, based on the principles of constructivism.

2.5 *Summary of chapter 2*

This literature review has covered four distinct concepts – games, gamification and gameful design, motivation and education. It has shown that the motivational power of games can be harnessed using gameful design in order to solve the problem of a lack of motivation in educational contexts (Figure 5). Most existing implementations of educational gamification are surface-level implementations that do not show a deep understanding of the satisfaction of the three basic psychological needs. There is a need to shift the focus of gamification away from the use of mere game elements towards a holistic understanding of why games are powerful motivators in order to craft effective educational gameful design solutions.

Chapter 3 provides the details of the case study research method used in this study as well as a discussion about the methods used to guide the design of the gameful website.

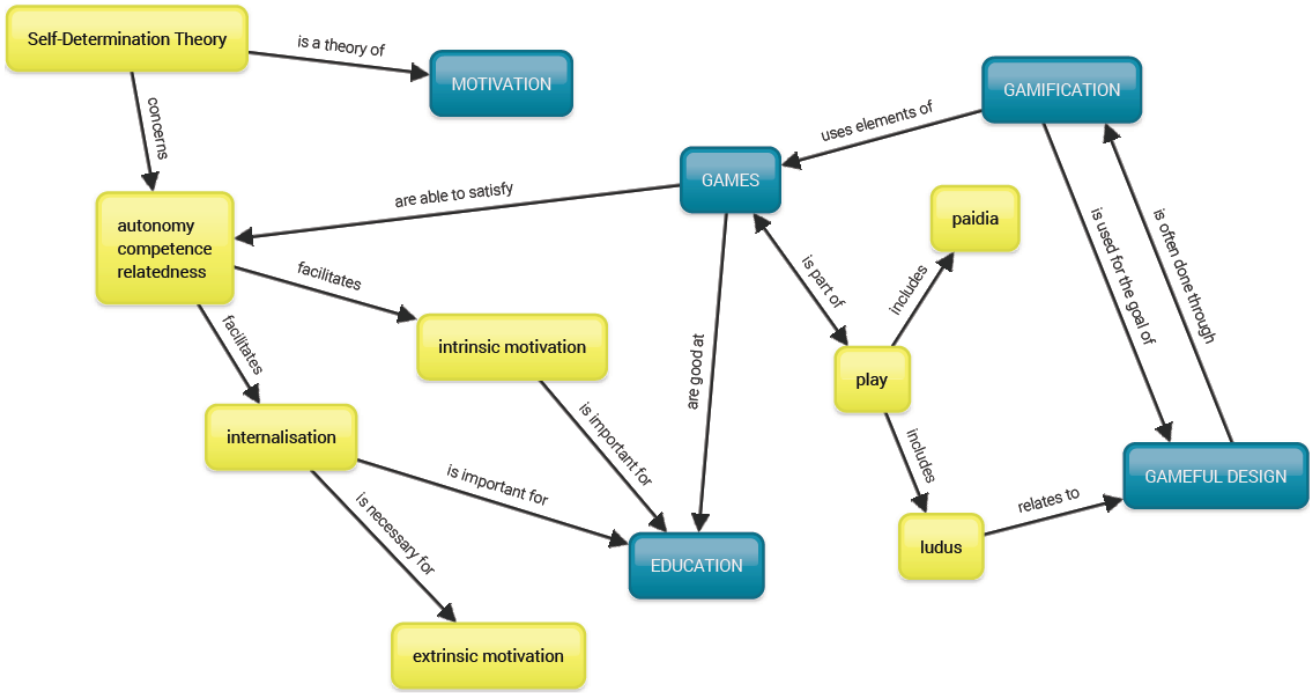

Figure 5 - A summary of the literature review concepts

3. Chapter 3 - Methodology

Chapter 2 provided a review of the literature which is relevant to this study. This chapter will first discuss the research methodology which was used in the study and then address the design methods used to guide the development of the gameful website.

This study investigated the effects of gamification on the motivation of students within a tertiary education setting. In order to determine whether the gamification intervention was able to achieve its goals, it is necessary for it to be studied within the setting where it is implemented. This led to a need to approach the study from the perspective described by an empirical interpretivist paradigm. This paradigm is applicable because it concerns the study of social phenomena within their natural settings (Pickard 2013:11).

The interpretivist paradigm implies a qualitative research methodology (Pickard 2013:13). Qualitative research involves conducting fieldwork in a natural setting (Pickard 2013:14; Denzin & Lincoln 2017:10) and results in some transformation of the world (Denzin & Lincoln 2017:10).

The qualitative research method that was used is a case study. A case study is an in-depth investigation of a real-world context with unclear boundaries between the context and the phenomenon in question (Yin 2013:16). These characteristics made it a fitting method to use in the context of the current study. Further motivation of this choice is provided in later sections of this chapter.

In addition to the use of a case study to analyse the intervention of the gamified system, it is also necessary to discuss the development of the actual system. The gamification method described by Deterding (2015), The Lens of Intrinsic Skill Atoms, was used to develop the system. The software development framework followed was the waterfall model.

The above-mentioned concepts will be discussed in detail below. First, the implementation of the case study will be covered. This will be followed by a discussion of how the website was developed.

3.1 The case study

This section consists of two main subsections. The first section describes the case study method as it is documented in the literature. The second section describes the research design of this study as it followed the case study method.

3.1.1 The case study research method

A case study is a method that provides an in-depth view of some phenomenon within its real-world context (Yin 2013:16). This sort of detailed knowledge is useful when a situation is not properly understood or the researcher wishes to investigate the effect of a certain intervention on a situation (Leedy & Ormrod 2012:135). Additionally, the delineation between the phenomenon being studied and the context itself is not clear (Yin 2013:16). This distinguishes a case study from an experiment, in which the boundaries between the phenomenon and context are clear. As a result of this, one main feature of a case study is the large number of variables of interest (Fidel 1984:37; Yin 2013:17). A second feature is the reliance on multiple sources of evidence as a means of triangulation (Yin 2013:17).

While the product of a case study is a detailed description of the case at hand, the aim is usually for the findings to be relevant to the broader areas surrounding the case (Fidel 1984:37; Gorman et al. 2005:47). This does not mean that they are generalizable, but they do serve to improve the general understanding of some phenomenon beyond the scope of the case study (Pickard 2013:86).

Merriam (2009:43) describes three characteristics of a case study: particularistic, descriptive and heuristic. Particularistic means that the case has a specific focus on some event, place or phenomenon. Descriptive refers to the end product of a case study as being a "thick description", which means that it is complete, literal and rich. Finally, the heuristic quality of a case study concerns its ability to clarify the reader's understanding of the phenomenon and to bring about new meaning.

3.1.1.1 When to use case studies

Yin (2013:10–12) describes three main conditions that can be used to determine when a case study is an applicable research method to use. The first condition is the type of research question. As part of their in-depth focus on a specific context, case studies are most often based on "how" or "why" research questions (Yin 2013:10); questions which are exploratory or descriptive by nature (Mouton 2001:10).

However, this alone does not exclude the use of a historical study or an experiment, which is why the second and third conditions serve to narrow the scope. The second condition concerns the extent of control that the researcher has over behavioural events and the third specifies the focus on contemporary events as opposed to historical events (Yin 2013:12).

A case study is unique in that it has no control over the behaviours that it is examining - unlike an experiment; and it is focused on contemporary events – unlike historical research.

3.1.1.2 Concerns about case studies

The primary limitation of case studies is their apparent inability to generalise the findings (Mouton 2001:150; Hofstee 2006:123; Leedy & Ormrod 2012:135; Yin 2013:20). Yin (2013:20–21) argues that in this sense, case studies are like single experiments. It is also not possible to generalise the results of a single experiment across an entire population. To do so requires multiple sets of experiments performed under various conditions. Since they do not represent a sample of the population, it is not possible to generalise the findings of a case study across the population; however, they can be used to "expand and generalise theories" (Yin 2013:21). The results of a case study can be generalised to theoretical propositions and this leads to a better understanding of a particular phenomenon.

Lack of rigour and the bias of the researcher are the two main potential sources of error when conducting a case study (Mouton 2001:150; Hofstee 2006:123; Yin 2013:19–2012). These concepts are related. When a researcher does not follow systematic procedures or allows themselves to be influenced by a certain result, rigour is lost and they have allowed their bias to affect the study. In order to avoid this problem, Yin (2013:20) suggests following a methodological protocol (case study design) that provides clear steps.

3.1.1.3 Types of case studies

A number of authors have described different categories of case studies. Merriam (2009:48) defines a descriptive study as one where the goal is simply to describe a phenomenon in detail with no attempt to build theory. This is similar to what Stake (1995) refers to as an intrinsic case study. Merriam (2009:48–49) also describes interpretive and evaluative studies. Stake (1995) mentions instrumental and collective case studies.

Yin (2013:8) mentions descriptive, explanatory and exploratory studies. Descriptive studies describe a phenomenon in its real-world context (Yin 2013:238). Explanatory studies are used to answer a question or describe presumed causal links in interventions (Baxter & Jack 2008:547). Explanatory studies can also be used to explain how or why some condition came to be (Yin 2013:238). Exploratory studies also examine the effects of interventions, but in these studies the intervention usually has no clear set of outcomes (Baxter & Jack 2008:547). Yin (2013:238) describes exploratory studies as being used to identify research questions or procedures that will then be used in a future study.

Furthermore, Yin (2013:50) describes different case study designs – single and multiple case studies, each of which can be either holistic or contain embedded units of analysis. A holistic design is useful when no logical sub-units of analysis can be identified. If it would be beneficial to examine various units of analysis in more details, then an embedded design is preferential.

3.1.1.4 Sources of evidence

Yin (2013:106) identifies six main sources of evidence for a case study: documentation, archival records, interviews, direct observations, participant-observation and physical artefacts. Using a number of different sources of evidence is one of the hallmarks of case study research (Vos et al. 2011:272; Pickard 2013:102; Yin 2013:119). This triangulation of data serves the purpose of supporting the same findings (convergence of evidence) and thereby strengthening the argument of the case study and its construct validity (Yin 2013:121). Construct validity is covered in more detail in section 3.1.1.7.1.

3.1.1.5 Selecting a case

One of the most important steps in planning a case study is choosing the case. Merriam (2009:40) views this as the most defining characteristic of this method since it is the specification of what will be studied. Choosing a case makes it possible to then determine which information to collect which makes the research project more feasible and manageable (Yin 2013:31). Cases can be defined in terms of a variety of dimensions – the nature and size of the social unit under study (e.g. communities, organisations etc.); spatially (e.g. a beach, a street, a classroom etc.); temporally (e.g. over a period of six months) or an event (e.g. a school staff meeting) (Miles & Huberman 1994:26). A case should be a specific entity, not the study of reasons or policies, which are considered more as generalities (Stake 2006:2).

Purposive sampling is the method used to determine which case(s) to use (Pickard 2013:104) since this allows for the selection of "information-rich cases" (Pickard 2013:64).

The phenomenon to be studied should have intrinsic boundaries that make it clear how data collection can take place in a finite way. If the phenomenon does not have these boundaries then it cannot be considered a case (Merriam 2009:41). Defining the boundaries is called "bounding the case" by Yin (2013:33). It is important because it will make the data collection, and the case study in general, manageable and realistic.

Stake (2006:2) explains that understanding what is and is not a case is fundamentally important because it relates directly to the epistemological stance of qualitative research. This is because the

context in which the case takes place affects the case and the way it is experienced and interpreted.

3.1.1.6 Designing a case study

Yin (2013:29–37) provides components that should be included in the research design of a case study. The first is the case study's questions. The questions are used to direct the study and also help to determine the research method (Yin 2013:10). Generally, a case study has "how" or "why" research questions because they are explanatory in nature (Yin 2013:10).

Secondly, the study propositions should be defined. These are used to help guide the research focus as they expand upon the research questions and indicate where to start looking for evidence.

In the third step, the case is defined. The fourth step requires linking the data to the propositions defined earlier. This means determining what kind of data gathering should take place in order to gather the correct evidence for the propositions and research questions. Planning this ahead of the actual data collection prevents problems with having too much or too little data and potentially having to return to the data collection phase.

Finally, the criteria for interpreting the findings are identified. This may include identifying rival explanations for the findings. It also requires the researcher to consider how the analysed data will be used to answer the research questions.

3.1.1.7 Ensuring quality

It is necessary to examine the main tests by which the quality of empirical social research is judged. The two main concepts of concern are validity and reliability (Silverman 2010:210, 220; Yin 2013:45).

3.1.1.7.1 Validity

Validity is linked to the concept of truth (Gorman et al. 2005:58) and it is described by Flick (2009:387) as a question of "Do researchers see what they think they see?". It is the extent to which the research provides a true picture of the phenomenon being studied (Gorman et al. 2005:58). Yin (2013:45–46) describes three different types of validity: construct, internal and external.

Construct validity requires identifying the correct operational measures for the concepts being studied (Yin 2013:46). To do this in a case study, Yin (2013:47) recommends the tactics of using

triangulation, establishing a chain of evidence and having the draft case report reviewed by key informants in the study.

Internal validity refers to establishing a causal relationship and being able to specify that certain conditions have led to other conditions (Yin 2013:46). This is only applicable in explanatory studies. Tactics for ensuring internal validity include pattern matching, explanation building, addressing rival explanations and using logic models (Yin 2013:48).

External validity deals with the problem of generalisability of results. As noted before, this is an issue of concern for case studies. Case studies aim for analytic generalisation, not statistical generalisation (Yin 2013:40). The latter is when an inference is made about a population; this is possible because the data were collected from a sample of the population. Since case studies do not have sampling units and are too small to be considered samples of larger populations, this is not possible. Analytic generalisation refers to the use of data to aim for generalisations beyond the conclusion of the study itself. External validity is ensured by using theory in single case studies and replication logic in multiple case studies (Yin 2013:45).

3.1.1.7.2 Reliability

Reliability specifies the ability of a method to continuously produce the same results (Gorman et al. 2005:55; Flick 2009:385). The goal is to minimise errors and bias in a study (Yin 2013:49). The use of a case study protocol and a case study database help to ensure reliability in a study (Yin 2013:45).

3.1.2 Research design

This section will describe the research design of the study based on the case study method described above. It will do so by following the procedure of the case study design as detailed by Yin (2013:84–93). This is followed by a discussion on the design of the research instruments as well as the limitations of the study.

3.1.2.1 Choice of case study research method

A case study is a suitable method for this study for a number of reasons. Firstly, the research questions indicate a need to gain a deeper understanding of the phenomenon of gameful design in higher education and a case study is able to make provision for this.

Secondly, the boundaries between a gamified website and the module in which it is implemented are not distinct. This is because of the nature of human participation. Human participation is

what allows the website to transition from merely being a functional system to something which affects the way students view their work and progress in the module. Human participation causes the website to become a topic of conversation among classmates and something which affects the manner in which lectures are delivered and received. Without people using it, the website would remain a simple technical implementation, but due to human involvement, it is a form of socio-technical system design (section 0).

The intervention permeates all areas of the module, making the boundaries between gameful design and learning unclear. This results in a number of variables which can be investigated and requires detailed examination in order for its effects to be understood.

Thirdly, the study relies on a number of sources of evidence – direct observation, focus groups, questionnaires and website use data. Finally, the results of the case study will strengthen research in the field of gameful design in education. They will do this by providing guidelines for designing and implementing gameful higher education systems, lessons learnt from the process and advice for future implementations.

3.1.2.2 Case study design

The following section describes the case study design of this study. The design consists of three main sections: an overview of the case study, collecting the evidence and analysing the evidence.

3.1.2.2.1 Overview of case study

The first part of the case study design involves explaining the important issues of the case study. This includes the rationale for selecting the case, the propositions, the sources of evidence that were used, and the way in which the data are linked to the propositions.

3.1.2.2.1.1 Selecting the case

The type of case study used was an explanatory study since the goal was to explain the link between the gameful system and the motivation of the students.

This study used an embedded, single-case design. The main unit of analysis in the case was "a gameful intervention implemented in a higher education context". A set of a priori criteria was established to determine which case should be selected – more specifically, to determine which higher education course module to select as a case. These criteria were:

1. The module must have a gameful intervention implemented in it.
2. The gameful intervention must have been tested before being implemented in the module. There was a gameful intervention implemented in another module (IMY 120 2016), but it was untested and the reason for the implementation was as a pilot study for the final website of this study.
3. The researcher must have access to the module as it is being presented. This is necessary in order to conduct the case study successfully.

Following the establishment of these criteria, a single case was found to match all three criteria. The case was the module of IMY 110 2017, a first-year undergraduate module at the University of Pretoria that teaches markup languages.

The module of IMY 120 2016, another first-year undergraduate module at the University of Pretoria, also had a gameful website implemented in it, but this module did not meet the second criterion as the website was untested when it was used in the module. IMY 120 2016 was used as a pilot study for the current study. It piloted the use of a gameful website in a university module in order to determine how the website should be modified for the final implementation in IMY 110 2017. The pilot study is explained in more detail in sections 3.2.2.1 and 4.2.

The case was bound in two ways. Firstly, the time frame was the semester in which the IMY 110 2017 module was run at the university since that was the only time when the website was used. Secondly, the participants were the students enrolled in the module and lecturer of the module, since they were the only people who used the website.

The rationale for the choice of a single case was the fact that it was an unusual case that deviated from everyday occurrences (Yin 2013:52). This is because the website was newly developed and aimed specifically at the IMY 110 module and this was the first time it was included in the module. For this reason, the 2017 implementation of the module deviated from how it had been run in the past, which made it an unusual case to study.

The choice of an embedded design (section 3.1.1.3) allowed for the detailed examination of all the areas of impact of the website. This is because the website had an effect on the actions of students within the module, including those beyond the website itself. Yin (2013:55) cautions the use of a holistic design if it might cause the researcher to "avoid examining any specific phenomenon in operational detail". For this reason, it was necessary to identify embedded units of analysis:

1. **Direct interactions with the website.** This unit of analysis focused on the way in which the website was used by the students.
2. **Indirect interactions with the website.** This unit of analysis looked at the ways in which the website impacted actions beyond its direct use. This included the interactions of the students with the lecturer about the website and any references made to the website during class time.

3.1.2.2.1.2 Questions and propositions

The research questions for this study are detailed in chapter 1. The case study questions are those which will be answered using empirical data gathered from the case study method and were therefore used to guide the case study. Those questions are:

1. Why is gameful design able to facilitate intrinsic motivation?
2. How can an educational gameful design system be designed to facilitate intrinsic motivation?

From the literature, three basic psychological needs of competence, autonomy and relatedness were identified as the requirements for intrinsic motivation (Ryan & Deci 2017:11). It was also established that intrinsic motivation is an important component in education (Deci et al. 1991:325–326; Schunk 2011:386). It can therefore be surmised that in order for a gameful system to facilitate intrinsic motivation in an educational context, it should meet the three basic psychological needs. As a result of these conclusions, the concepts of autonomy, competence and relatedness can form the basis of the propositions of the case study:

- Autonomy – having freedom of choice in an environment. Games are good at providing autonomy because they allow players to choose what they want to do and in which order to do it. A gameful education system which gives users a choice in how they would like to practice and improve their skills by giving them access to multiple ways to do so will enhance autonomy.
- Competence – feeling effective in one's interactions with the environment. Games provide feelings of competence by presenting players with challenges and goals towards overcoming them. Educational settings contain challenges by default, but gameful systems can turn these learning challenges into gameful experiences through the principle of intrinsic integration. Positive, timeous feedback will also contribute to feelings of competence within a gameful system.

- Relatedness – the feeling of belonging and acceptance within a community. Games make players feel as though what they are doing matters, which fosters feelings of relatedness. In an educational setting, it is important that students feel connected to others. Gameful education systems can allow students to feel a part of something greater than themselves by making the process of learning a connected and community-based activity.

An understanding of how the three basic needs relate to gameful design as well as to education will guide the data gathering of the case study and make it possible to answer the questions of the study. In summary, for gameful design to be effective in education, it should satisfy the three basic psychological needs.

3.1.2.2.1.3 Sources of evidence

Evidence for the case study was collected from four main sources in order to ensure triangulation of data. Each of these sources is discussed below.

3.1.2.2.1.3.1 Archival records

Archival records in this study took two main forms. The first was database records retrieved from the database of the gameful website. The second was Google Analytics data. Both are sources of data collected in the background throughout the semester while the website was active. They are also quantitative data. Although this study followed a qualitative research methodology, quantitative data was used to support qualitative statements and conclusions. This source of evidence was used to understand the first unit of analysis – direct interactions with the website.

3.1.2.2.1.3.2 Questionnaires

Questionnaires were used to gather data from the user group as a whole. This made it possible to gather data from almost every user of the website in a short space of time. The questionnaires contained a combination of closed- and open-ended questions. The questions also produced both qualitative and quantitative data. Quantitative data was used to support qualitative statements as well to gain a measurement of the frequency of use of the various components of the website.

The questionnaires were administered at the end of the semester, when the user had engaged with the website for the full semester. They were followed by the focus groups.

3.1.2.2.1.3.3 Focus groups

Focus groups are helpful because individuals are likely to feel more comfortable speaking to their peers than directly to an interviewer (Gorman et al. 2005:49). This is especially true in this study as the researcher was also the lecturer of the module. Focus groups also allow for a range of opinions to be expressed as well as for in-depth discussion about a particular topic (Pickard 2013:244).

The questionnaires and the focus groups were the primary forms of data collection for this study and their purpose was to determine whether and to what extent the website met the three basic psychological needs of the students, as well as the students' orientation and level of motivation towards the module. Additionally, they were also used to ascertain how the website was used by the students in order to determine how it could be improved for future use. This source of evidence was used to understand both units of analysis defined in section 3.1.2.2.1.1).

Yin (2013:110) discusses the sources of evidence which can be used to gather data for a case study. He includes both focus groups and questionnaires (which Yin calls surveys (Yin 2013:112)) in the category of interviews. For clarity, this categorisation has been avoided in this section.

3.1.2.2.1.3.4 Direct observation

Direct observation was conducted by the researcher, who was also the lecturer for the module in question. It took place during class times. The data collection process consisted of taking notes of interesting occurrences for the purpose of determining the general attitude of the students towards the website as well as the way in which it was used. This source of evidence was used to understand the second unit of analysis – indirect interaction with the website – as it was concerned with observations about the indirect use of the website.

3.1.2.2.1.4 Linking the sources of evidence to the propositions and questions

The primary use of the data collected was to validate a logic model (section 3.1.2.2.3.5) created for this study. The model was used as a visual means of representing the results and their effects. Validating the logic model would make it possible to determine whether the three basic psychological needs of the students were met by the website as well as how they were motivated during the course of the module. It was important to determine whether the website was the cause of this motivation of whether it was due to another factor of influence. This answered the first case study question.

Additionally, the data gathered were used to understand how the website was used by the students in order to propose changes that could be made for future implementations. This contributed towards answering the second case study question.

3.1.2.2.2 Collecting the evidence

This section deals with the manner of collection of evidence for the case study. It will also cover with ethical and practical issues which arose during the study.

3.1.2.2.2.1 Archival records

The archival records were gathered from two sources – the website database and Google Analytics. This took place at the end of the semester when the website was no longer in use.

The appropriate data from the database were transferred to spreadsheets to allow for quantitative analysis. These quantitative data were used to support the qualitative data. Not all the data in the database were relevant as some of them were used to keep track of users or in the administrative parts of the module, therefore only specific tables were adapted to a spreadsheet version.

The Google Analytics data did not need to be manipulated before being analysed. The interface provided by Google for this tool is powerful enough to allow for the data analysis. It allows the user to create customised views of the data based on specific time frames and variables and this was sufficient for the purposes of this study.

3.1.2.2.2.2 Questionnaires

The questionnaires were administered in electronic format using Google Forms. There were two reasons for this choice. Firstly, there was provision for them to be administered inside a computer lab which made the use of electronic surveys easy. Secondly, they were quite lengthy which meant that when explanations for answers were required, the participants would be able to complete them faster by typing instead of writing. Thirdly, the use of electronic questionnaires made data analysis faster as the data were already electronically available.

Before starting the questionnaire, the participants were presented with an informed consent section, explaining the nature of the study and their involvement in it. They were required to provide their consent in order for their questionnaire data to be used. The questionnaire was conducted anonymously and was completed by 28 participants out of a total of 34 students who were enrolled in the module at the end of the semester.

The collection of the questionnaire results was done automatically by Google as a part of the Google Forms service. It was transferred to a spreadsheet which could be downloaded.

3.1.2.2.2.3 Focus groups

Following the completion of the questionnaires, participants were made aware of the focus groups which would be taking place. They were given the option to participate in these group interviews by filling in a simple electronic form to indicate their willingness. The form required them to rate their level of participation on the website on a scale of one to five. A value of one corresponded to "I only used the website when the module required me to" and five corresponded to "I used the website very often". This was done to divide the focus group participants into groups based on their level of activity on the website.

Two focus groups were held. The first focus group consisted of five participants who indicated a high level of participation with the website. The second group contained four participants who indicated that they had not interacted with the website as much. The reason for this way of dividing the participants was to allow the conversation to progress quickly to in-depth topics concerning the website, since all participants would have had more or less the same amount of interaction with the website.

The questions prepared for the focus group followed a semi-structured interview format (Merriam 2016:110). This allowed for flexibility to pursue interesting topics that arose during the session.

Before the start of the session, participants were required to sign informed consent forms. The sessions were recorded using audio recording equipment. Each focus group lasted one hour and participants were provided with refreshments as a token of appreciation for their input.

The audio recordings were transcribed for further analysis.

3.1.2.2.2.4 Direct observation

Direct observation took place in a casual rather than a formal manner. This method was made possible due to the fact that the researcher was also the lecturer for the module in which the website was implemented. The observation was conducted by taking note of comments made by students during class time.

These data were used to support conclusions drawn from the other sources of evidence. It also contributed to the qualitative-richness of the case report by providing evidence of interesting events and conversations that took place within the context.

3.1.2.2.3 Analysing the evidence

The evidence from the case study was analysed using a logic model. Before this could be done, the data gathered needed to be coded. The following section discusses the process of coding qualitative data. It then provides an overview of logic models and describes the logic models developed for this study.

3.1.2.2.3.1 Coding

Coding was used to analyse the qualitative data gathered from the questionnaires and focus groups. Coding is a process of analysis which allows raw qualitative data to be developed so that concepts and theory can be derived from them (Corbin & Strauss 2008:65–66). The first step in this process is called open coding which involves questioning and comparing the data in order to develop and attach codes to them (Corbin & Strauss 2008:69–74; Rogers, Sharp & Preece 2015:297). Axial coding follows this and it involves further developing the codes by relating concepts to each other (Corbin & Strauss 2008:195). Finally, selective coding (Rogers, Sharp & Preece 2015:297) or integration (Corbin & Strauss 2008:263) is concerned with linking the categories around a central category in order to construct a theory.

3.1.2.2.3.2 What are logic models?

Logic models are a visual means of presenting an idea or a program (Knowlton & Phillips 2008:4). Logic models are used to describe both the planned actions and expected results of a project (Knowlton & Phillips 2008:5). The use of logic models is popular in the implementation and evaluation of programs. Programs can have a broad range of meanings, but generally they refer to some initiative, action or intervention which makes an effort to enhance human well-being and to change the knowledge, attitudes or behaviours in a group or an individual (Chen 2015:3). This is why logic modelling is also referred to as program logic modelling.

Logic modelling also forms part of what Chen (1990) calls theory-driven evaluations. This is a move towards incorporating theory in the evaluation of programs instead of simply relying on methods (method-oriented evaluation). Chen (1990:28) and Lipsey (1993:33) argue that over-reliance on methods during the evaluation process is akin to treating the phenomenon like a black box with inputs and outputs, but with no real understanding of the underlying causes of the outputs due to the inputs. This failure to identify the causes of the outputs results in an inability to determine the areas where a program may be lacking and could be improved in the future (Chen 1990:18). Conversely, theory-driven evaluation seeks to understand the causal mechanisms within the black box so as to gain a better understanding of the program as a whole as well as to generate more sound conclusions about the success of the program (Chen 1990:18).

Chen (2015:4) describes a program intervention as an open system consisting of input, transformation, output, environment and feedback. Figure 6 represents this view.

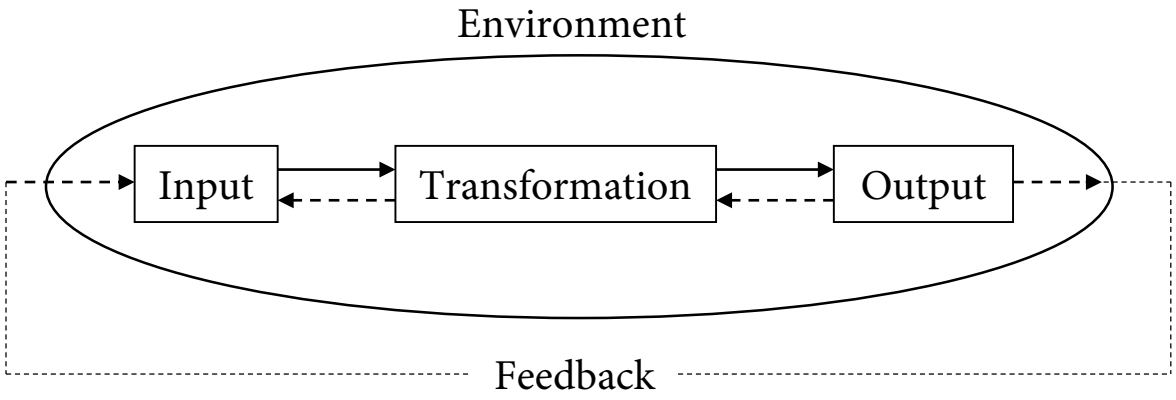

Figure 6 - A systems view of a program (Chen 2014:4)

The inputs are the resources acquired from the environment that are needed to sustain the program. Transformation is the process by which the inputs are converted to the outputs; the inside of the black box. The outputs are the results of the transformation, ideally the attainment of the goals of the program. The environment refers to factors that are not part of the program but still have an effect on it; this is why a program is an open system. Finally, the feedback (represented by dotted lines) is the basis of the evaluation of the program and it is used to determine whether the program was a success and how it can be improved.

The detailed explanation of how the transformation takes place within a program is called a program theory and it is usually displayed in the form of a logic model (Funnell & Rogers 2011:31–32). Their visual nature is what makes logic models useful because they can clearly depict complicated relationships between elements (Knowlton & Phillips 2008:4). Furthermore, logic models are able to clarify both what works and why it works. (Knowlton & Phillips 2008:4), thus removing the black box. As Yin (2013:156) puts it, "by using logic models, case study research can 'open' the black box".

It is important to note that a logic model is not a guarantee of logic: "…a logical representation does not equal plausibility, feasibility, or success" (Knowlton & Phillips 2008:11–12). It is merely able to guide data analysis by allowing empirically observed events to be matched to theoretically predicated events (Yin 2013:155). Using qualitative analysis, the proposed model can be accepted, rejected or modified and the data can be used to substantiate the decision (Yin 2013:156).

3.1.2.2.3.3 Types of logic models

Program theory and logic models can be used at all stages in the program life cycle – during planning, implementation and evaluation (Chen 2015:37–38).

Funnell and Rogers (2011:242–250) describe four different approaches to logic models, with two of these being primary approaches and the other two being supplementary models. The two main types of logic models are described below:

- **Pipeline logic models:** represent an intervention as a linear process, with inputs on one side and impacts on the other. The activities within the intervention are depicted near the start, which might not be the case in all situations as they might each occur at a different time. Additionally, this type of model also requires defining the resources and outputs of the intervention.
- **Outcomes chain logic models:** the main feature of this type of logic model is that each box is considered a result. Starting with an initial result and ending with the final desired result. This type of model is effective at showing how the intervention works by showing the linked chain of outcomes and how each is caused.

The two supplementary types of logic models, intended to be used to aid the understanding of the primary logic model, are realist matrices and narratives:

- **Realist matrices**: focus on a specific causal mechanism within the program theory and explain the contexts in which this mechanism will work to produce the desired outcomes. The idea is to address the more complex parts of an intervention with the question, "What works for whom in what situations?" (Funnell & Rogers 2011:248).
- **Narratives:** these are a helpful way to explain a logic model to a person who was not involved in its development and therefore does not understand the intricacies of it. They help to simplify the direction and meaning of the arrows in the diagram and are therefore considered a complement to one of the primary logic models.

3.1.2.2.3.4 Applicability of a logic model in this study

There are a number of motivations for the use of a logic model in this study.

- There is a general understanding that gameful design has the potential to improve intrinsic motivation. A logic model would allow a look 'inside the black box' to gain an understanding of why this is possible and how it can be achieved.
- A logic model, even a simple one, is an applicable way to describe the way in which the gameful website was implemented in the module and the causal mechanisms behind the results obtained. It provides a good overview of the findings of the study.
- The empirical results have the potential to highlight weaknesses in the logic model which will contribute to future work in the field as well as to show how the implementation can be improved.
- The logic model takes a broader look at the use of a gameful website, since it does not only focus on the website itself, but also the way in which the inclusion of the website in module as whole has an effect on the students. This highlights the importance of the context of implementation.

3.1.2.2.3.5 The logic models of this study

Figure 7 represents the primary logic model for this study. It should be read from left to right, with the intended impact of the gameful website shown in the rightmost blocks. Since this is an outcomes chain logic model, each block can be considered a result based on the input from the previous block.

The block in column A is the result of implementing the website in the IMY 110 2017 module. The website is compulsory to use as it is necessary for module admin; however, due the addition of the optional gameful elements, it assumed that these optional parts of the website will also be used. How much these optional parts were used by each student is addressed by the realist matrix logic model shown in Table 4.

Column B shows the result of using the website – the three needs are satisfied. This is due to the addition of the gameful elements, each of which is intended to satisfy a psychological need in some way. This is discussed in detail in chapter 4. The result of satisfying these needs is shown in column C. This takes place in two ways:

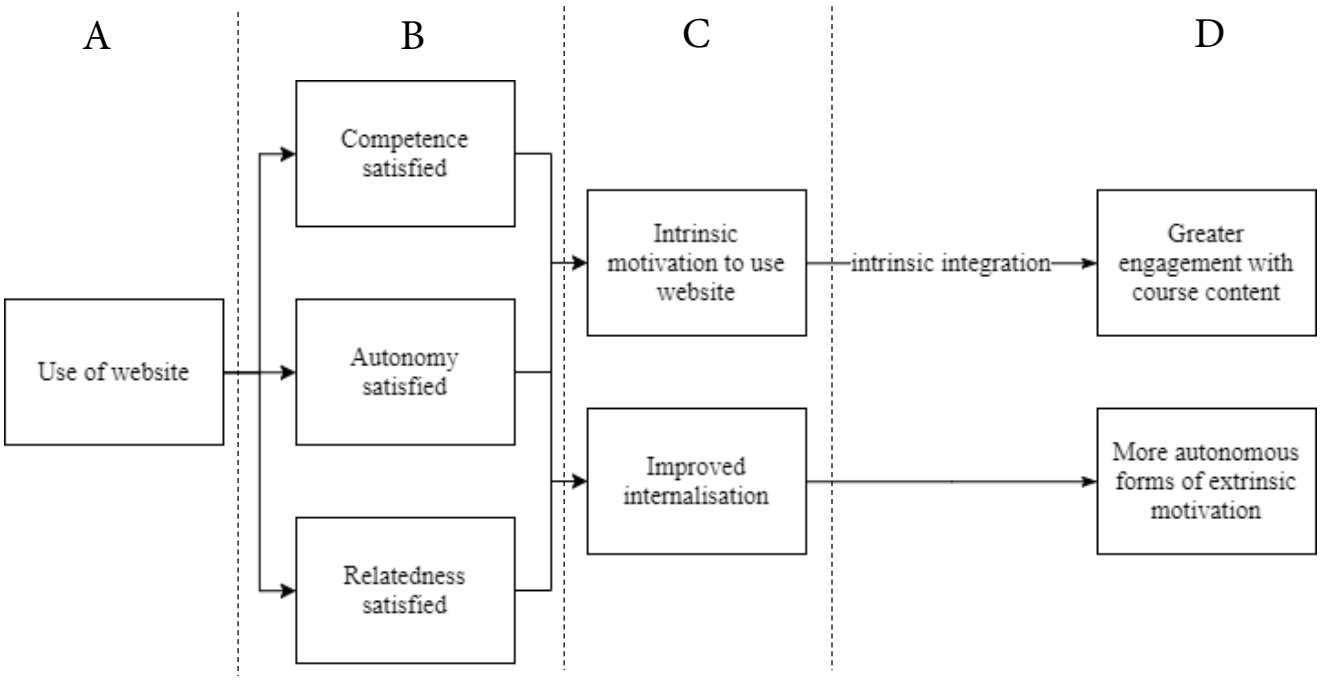

Figure 7 - The outcomes chain logic model for this study

- Firstly, due to the website using only intrinsic motivation to encourage students to use it, the satisfaction of the three needs will continue to motivate the students intrinsically to use the website. Due to the fact that gameful design hinges on the concept of intrinsic integration (section 0 and section 0), using the gameful parts of the website would directly result in the students engaging more with the course content. This is shown in column D.
- Secondly, internalisation will improve which means that if students were extrinsically motivated towards the course content, the form of extrinsic motivation will become more autonomous as shown in column D of Figure 7 (section 2.1.1.2.2.2).

Since it cannot be assumed that all students will use the website to its full potential, a realist matrix logic model (Table 4) is supplied to describe the context in which the model will be successful.

Situation	Context	Mechanism	Outcome
I	Students who use most of the gameful parts of the website	Gameful elements	Need satisfaction
II	Students who use a few of the gameful parts of the website	Gameful elements	Partial need satisfaction
III	Students who do not use the gameful parts of the website	Gameful elements have no effect	No need satisfaction

Table 4 - A realist matrix logic model of the use of the gameful website

This model describes the three different contexts into which students can fall. On the one end, they can use the website fully, the intended result of which would be need satisfaction due to the mechanism of gameful elements (situation I). On the other hand, if the students do not engage with the gameful parts of the website at all, need satisfaction will not take place (situation III). Additionally, there are some students who might engage with a few sections of the website, in which case partial need satisfaction would result (situation II). It is important to supply this realist matrix to supplement the outcomes chain logic model because it is unreasonable to assume that all students will react to the website in the same way. The ideal situation for all students would be situation I, in which case the results of the outcomes chain logic model will apply fully, but in reality, this is not always possible.

Finally, as a means of tying these two logic models together and explaining the program theory in a cohesive manner, the following narrative representation is used:

The gameful design of the website works with students who engage with the optional gameful elements. Their interaction with these elements facilitates the satisfaction of autonomy, competence and relatedness which leads to the facilitation of intrinsic motivation. This is intrinsic motivation to use the website. Due to the concept of intrinsic integration, the facilitation of intrinsic motivation means that the students spend more time engaging directly with the course content. Additionally,

the satisfaction of the three needs leads to increased internalisation and more autonomous forms of extrinsic motivation to learn the content.

This narrative representation is helpful because it succinctly summarises the previous two logic models in a single paragraph. Assuming these logic models are proven to be correct by the results of the study, this narrative representation is a helpful way to summarise the overall effects of the gameful website.

These logic models are based on the extensive findings of self-determination theory and the underlying assumptions about the effectiveness of games and gameful elements as discussed in section 2.1.1, section 2.1.3 and section 2.4.4.2.

3.1.2.3 Designing the instruments

This section will consider the design of the data gathering instruments used in the study. The design of the questionnaires and focus groups will be discussed.

3.1.2.3.1 Questionnaires

This study used a questionnaire in order to gather data about the students' use of the website and their motivation towards the module.

3.1.2.3.1.1 Appropriateness of the instrument

Questionnaires are applicable to use in a case study as a means of supplementing the data gathered through other means (Yin 2013:112–113).

The reason for the choice of a questionnaire was to gather a large amount of data from the students in relatively fast and easy way. This is because it would not be possible to get as many students to attend voluntary focus groups. This was evident in the data gathering phase of the pilot study. Additionally, the ability to administer the questionnaires electronically made it possible for the respondents to add more detail to the open-ended questions since the process of typing would be faster than writing.

3.1.2.3.1.2 Design

The first half of the questionnaire focused on the general motivation of the students and their perception of the module. The second half was concerned with their use of the website and their feelings concerning it. The questionnaire primarily collected qualitative data, but it also included some Likert scales and multiple-choice questions as a means of quantitatively supporting conclusions made.

Table 5 shows the parts of the questionnaire and the concepts under study by each part. Some parts of the questionnaire were based on previously developed questionnaires used in the field of self-determination theory. It was therefore applicable to use them in this study. These questionnaires are copyrighted, but free to use in academic research projects.

Questionnaire item(s)	**Concepts under investigation**
Section 1 (Appendix A, question 2-5), 5 (Appendix A, question 12-17)	General feelings towards the module.
Section 2 (Appendix A, question 6)	Perceived competence scale (Williams & Deci 1996; Williams, Freedman & Deci 1998).
Section 3 (Appendix A, question 7-8)	Academic motivation scale (Vallerand et al. 1992).
Section 4 (Appendix A, question 9-11)	Learning self-regulation (Williams & Deci 1996).
Section 6 (Appendix A, question 18-19), 7 (Appendix A, question 20-23)	Measure of intrinsic motivation towards the content.
Section 8 (Appendix A, question 24-28)	Level of engagement with the website.
Section 9 (Appendix A, question 29-38), 10 (Appendix A, question 39-46)	Level of engagement with the gameful parts of website and reasons.
Section 11 (Appendix A, question 47-50), 12 (Appendix A, question 51-54), 13 (Appendix A, question 55-60)	Effect of the website on free choice and perception of the course content.
Section 14 (Appendix A, question 61-62)	Effect of the website on intrinsic motivation.
Section 15 (Appendix A, question 63-66)	General feelings about the website.

Table 5 - Parts of questionnaire and concepts under investigation

Section 3 (Appendix A, question 7-8) of the questionnaire is based on the Academic Motivation Scale developed by Vallerand et al. (1992) which is used to measure the motivation of college students. This scale was adapted for use in the current study. It was used because it would provide a good understanding of the individual motivation of each student.

Two additional scales developed by Edward Deci and Richard Ryan were also adapted for use in the questionnaire. The first is the Perceived Competence Scale (Appendix A, question 6) which is used to assess participants' feelings of competence towards a particular activity. It has been used in two studies (Williams & Deci 1996; Williams, Freedman & Deci 1998). It was included in this

questionnaire to aid the assessment of the students' feelings of perceived confidence as this could affect the way they view the module and the website.

The second scale is the Self-Regulation Questionnaire (Appendix A, question 9-11) which assesses individual differences in the type of motivation that individuals have towards an activity. This scale has also been used a number of studies (Grolnick & Ryan 1989; Ryan & Connell 1989; Williams et al. 1996; Ryan & Deci 2000b). It was used in the questionnaire to determine the students' type of motivation in the module.

The data from section 1 and section 5 were not used in this study. These sections were included to introduce the respondents to the questionnaire topics in an easy way in order to reduce any feelings of nervousness.

3.1.2.3.1.3 Administration and scoring

A convenience sampling method was used in a group setting to administer the questionnaires. The questionnaires were in an electronic format, created using Google Forms. They were completed electronically in a computer lab during a class for the module in which the website was implemented. This meant that the highest possible number of respondents could be reached.

Before the questionnaire was completed, the researcher provided a brief explanation of the study. The first section of the questionnaire also explained the study and required students to provide their informed consent for the use of their data. The questionnaire was conducted anonymously. Respondents were then given an hour in which to complete the questionnaire, which it was estimated would take about 40 minutes to complete. The researcher was present during this time to answer any questions. The questionnaire was completed by 28 out of a total of 34 students enrolled in the module. All the respondents provided their consent for their data to be used in the study.

The quantitative parts of the questionnaire were converted in graphs to make data analysis easier. The quantitative data were coded to reveal categories of interest.

3.1.2.3.2 Focus groups

Focus groups were used to discuss opinions about the website in a more in-depth way than could be covered by the surveys. In this sense, they were used to expand upon the data gathered by the questionnaires.

3.1.2.3.2.1 Appropriateness of the instrument

Focus groups are a specific type of interview that involves gathering data that are socially constructed from the interaction that takes place among the group participants (Merriam 2016:114). This is applicable to the current study because the goal is to explore opinions about the website in an in-depth way. The focus group participants would all have used the website and therefore there is common ground from which to proceed into a more in-depth discussion (Flick 2009:197). Focus groups are preferable over individual interviews in this case because individual interviews produce opinions which are detached from everyday forms of communication (Flick 2009:197). Conversely, opinions delivered in a group tend to be closer to the everyday way in which they would usually be given because of the informal dynamics of a group conversation as opposed to the potential for nervousness that might arise during an individual interview (Flick 2009:197).

3.1.2.3.2.2 Design

The focus group questions were designed after some time was spent looking at the results of the questionnaires. The questions developed for the focus groups can be found in Appendix B.

The questions were aimed at finding out how the students used the website, how they felt about using it and how it made them feel with regards to the module and the work in it. There were also questions aimed at finding out how the students felt about the class discussions on the website achievements and whether they had any recommendations on how the website could be improved in the future.

The questions were structured to move from simple to more involved. The five categories of questions suggested by Morgan, Krueger and King (1998:21–28) were used. First, an opening question was asked to put the participants at ease. This question was not intended for data collection purposes. Following this, an introductory question introduced the general topic of the website, transition questions explored the concepts from the introductory question in more depth and led toward the key questions. The key questions were concerned with the primary data needed from the focus group. Finally, an ending question allowed for final thoughts and overall opinions.

3.1.2.3.2.3 Administration and scoring

All participants who had completed the surveys were given an opportunity to attend the focus groups. They were asked to complete a short form where they indicated their level of use of the website throughout the semester. This was so that they could be divided into appropriate groups.

A total of 9 participants volunteered for the focus groups. They were divided into two groups depending on their level of use of the website. It was decided to use homogenous group compositions so that surface-level topics which would have been covered by the survey could be avoided. The participants would have spent similar amounts of time using the website and therefore they would have common ground from which to begin the discussion.

The first group contained 5 participants who had all spent a lot of time using the website. The second group contained 4 participants who had spent less time using the website.

The focus groups lasted an hour each. They began with the participants being provided with an informed consent form which required their signature in order for them to participate in the group. Following this, a brief introduction was given by the researcher. The discussion of the group was recorded using audio recording software. After the focus groups, the participants were provided with refreshments as a token of thanks for their participation.

To analyse the focus groups, the audio recordings were transcribed and the data were coded.

3.1.2.4 Limitations

A limitation evident in the study is the use of a single case study instead of multiple cases. The reason for this is two-fold. Firstly, there was an opportunity to use the module in which the website was first implemented (IMY 120 2016) as a second case, but it was decided that it would be more valuable to use this as a pilot study in which to test the website and uncover potential problems within the system itself. This proved to be a good decision as many technical problems were found and fixed. This can be viewed as a type of iterative prototyping, as described in section 3.2.2.5.

While the use of the website in IMY 120 2016 was not intended to test the effectivity of the gameful website as a whole, the implementation revealed that the course content of IMY 120 is not ideally suited to gamification. A potential hypothesis for this is the fact that the course content for IMY 120 is focused on content creation using the Adobe software suite. This means that most of the skills which can be tested require some form of creativity. The gameful website provided students with tasks to do in order to progress on the system, and the rigidity of these tasks as well as their lack of integration into the website system, prevented the students from enjoying creative freedom when doing them. This affected the motivation of the students to use the website. This hypothesis was formed from the data gathered at the end of the pilot study through a questionnaire and focus group (section 4.4.1). The confirmation of this hypothesis requires additional testing which is beyond the scope of this study.

Secondly, a single case study does not minimise the potential for useful results and analytic generalisations. The choice of the case makes this an unusual case study since it is a rare occurrence for a university module to have a gamified website. According to Yin (2013:52), this is reason enough for a single case study. A single case study allows for a thorough investigation. Gorman et al. (2005:47) support this by saying, "a single site case study is not synonymous with superficiality".

3.2 Development of the gameful design system

The gameful design system was developed according to the method described by Deterding (2015). The following section will first describe the reasons for the selection of this method. Following this will be a detailed description of the method and it how it was applied, including a description of the software development methodology that was followed.

3.2.1 Choice of design method

In order to determine which framework would be used for the development of the gameful system, a search was conducted to find the available gamification and gameful design frameworks and methods.

The search used the keywords *"gameful design AND (method OR framework OR guide)"* and *"gamification design AND (method OR framework OR guide)"*. In addition, the literature reviews of gamification design frameworks conducted by Mora et al. (2015) and Mora et al. (2017) were used to find any other frameworks which may have been missed in the search. The literature review results were divided into categories and only the learning and generic frameworks were considered in this study. This excludes business and health frameworks identified.

A total of 24 frameworks were identified. These were then examined according to the following criteria in order to determine a fit with this study:

A. Intended for higher education or is a generic framework.
B. Is a scholarly, peer-reviewed work.
C. Is detailed enough to inform the design of a full system.
D. Provides a definition for gamification.
E. Is a framework to aid the design of a system, it is not a conceptual framework.

Table 6 shows the frameworks found along with criteria which were met.

Study	**Criterion(ia) met**
AlMarshedi et al. (2015)	**All criteria met**
Aparicio et al. (2012)	A, B, D, E
Chou (2015)	A, C, D, E
Deterding (2015)	**All criteria met**
DiTommaso (2011)	A, C, D, E
Fitz-Walter (2015)	A, C, D, E
Kappen and Nacke (2013)	B, C, D, E
Klock et al. (2015)	A, B, C, D
Kotini and Tzelepi (2015)	**All criteria met**
Marache-Francisco and Brangier (2013)	**All criteria met**
Marczewski (2013)	A, C, D, E
Manrique (2013)	A, C, D, E
Mora et al. (2015)	A, B, D, E
Morschheuser et al. (2017)	**All criteria met**
Nah et al. (2014)	A, B, D, E
Nicholson (2012)	A, B, D, E
Nicholson (2015)	A, B, E
Robinson and Bellotti (2013)	A, B, D, E
Sakamoto, Nakajima and Alexandrova (2012)	A, B, C, E
Silpasuwanchai (2016)	A, B, C, E
Simões, Redondo and Vilas (2013)	B, C, D, E
Versteeg (2013)	A, C, D
Werbach and Hunter (2012)	A, C, D, E
Wongso, Rosmansyah and Bandung (2014)	A, B, D, E

Table 6 - Gamification and gameful design methods and frameworks identified and criteria met

Frameworks which matched all the criteria were then further analysed. Below is a discussion of each of the remaining five frameworks. Table 7 provides a summary of this information.

3.2.1.1 AlMarshedi et al. (2015)

The framework proposed is aimed at aiding in the development of gamified systems with the goal of having long-term effects on the users. For this reason, the focus of the framework is on facilitating intrinsic motivation instead of extrinsic motivation. It does this by focusing on the user's purpose, relatedness and competence. Once these needs have been met, the user's interest in the gamified system will be sustained as it facilitates feelings of mastery, autonomy and flow. The framework is based on flow theory (Csikszentmihalyi 1990), self-determination theory (Ryan & Deci 2017) and Pink's drive motivation elements (Pink 2009).

While the framework specifies that a focus on intrinsic motivation is important in order to attain sustainable results, it is unclear exactly how feelings of relatedness, autonomy and competence can be facilitated. This is due to the lack of practical examples provided in the article. For example, the only suggestion to facilitate autonomy is to make the application voluntary.

The framework also suggests starting the process by "identifying the user's purpose, relatedness and competence". It is unclear how to practically proceed with this task, and given the literature covered in chapter 2, it is also unclear exactly what it means to "identify" relatedness or competence. Assuming that it is possible to identify these characteristics, the framework advises that these three elements "should be balanced and work in harmony", but it does not provide guidelines on how to balance the concepts.

In summary, there is a lack of explanation on how to apply this framework in a practical way when designing a gameful system as well as lack of empirical support for the framework.

3.2.1.2 Deterding (2015)

The proposed method is based on the principles of gameful design discussed in section 0. The method is prefaced by a discussion about the motivating qualities of gameplay and how they can be transferred into a non-game context. This gives the framework a game studies perspective and it shows an understanding of gameful design.

The method consists of five steps, beginning with a Strategy – which involves understanding the users and the context. Following this is Research in which one determines whether gameful design would be a helpful solution to the problem identified. The Synthesis and Ideation steps are used to design the system using the provided design lenses as guides (see section 3.2.1.7) and finally, Iterative Prototyping is used to ensure that the desired results are achieved.

This method has been developed and refined in 19 design projects and training workshops, but it does not have peer-reviewed empirical support.

This method differs from the other four methods being compared because it is the only one which is concerned with gameful design instead of gamification. In this sense, the method does not meet criterion D specified in section 3.2.1. However, as described in section 0, gameful design is interlinked with gamification. Gamification describes a design strategy while gameful design describes the goal of affording gamefulness. Gamification also tends to follow an inherent, additive approach as opposed to the systemic, emergent approach of gameful design (section 0). For this reason, this method was included in the comparison because gameful design is preferable to gamification.

3.2.1.3 Kotini and Tzelepi (2015)

The proposed framework is aimed at developing activities for computational or analytical thinking through the use of gamification elements. It is student-centred in the sense that the objectives of the activities are jointly shaped with the students so that they receive a personalised learning experience and feel responsible for their own learning. The framework is also based on intrinsic instead of extrinsic motivation. It is intended to aid teachers in creating lesson plans, specifically within the realm of computer science education.

At its core, the framework is based on constructivist learning principles, gamification elements and computational thinking skills. With regards to the gamification elements suggested, they are chosen because they conform to constructivist learning principles. This suggests that this framework is less focused on creating gameful experiences and more focused on adhering to a single learning theory. The source of the chosen game elements is not specified and there is no evidence that they are based on game studies literature. Additionally, in some ways they conflict with the purpose of the framework, which is to facilitate intrinsic motivation. For example, one recommended game element is rewards. The work provides examples of rewards such as giving students additional grades or a deadline extension. However, this is likely to shift the PLOC from internal to external (section 2.1.1.2.1.1) and can be considered a type of extrinsic motivation.

The way in which the framework is structured approaches gamification as though it is a self-contained element and in doing so, fails to acknowledge the role of games in gamification by omitting any discussion of underlying game studies concepts. It also differs in its view of how game elements and motivation work together. This can be seen when the paper refers to game

elements like points, levels and achievements as “external motives”. This contrasts what is discussed in section 2.1.3.4 about intrinsic and extrinsic motivation in games.

In the context of the current study it is also not fitting because it does not advise the design of a fully-fledged gamified system, but focuses on singular classroom activities and lesson plans.

3.2.1.4 Marache-Francisco and Brangier (2013)

The authors present a process which can be followed when creating gamified systems. The process begins with an analysis of the content to be gamified and an understanding of the users of the system. Following this is the choice of which gamification experience to design for. The design decisions made are prototyped and tested with users until the system is efficient. The choice of gamification elements is guided by the use of four tools: (1) different categories of gamification elements (derived from a comprehensive literature review), (2) six core principles of gamification, (3) factors which influence the perception of gamification elements and (4) decision trees which guide the selection of the elements.

The shortcoming of this method is that the process of gamifying a system is reduced to adding game elements to the situation. This is the inherent-additive approach discussed in section 0 which is the reason why gamification of often criticised as having a narrow view of games (section 0). Simply adding gameful elements to a situation does not necessarily result in the desired gameful experiences. Those experiences are the result of iterative prototyping because they are systemic emergent properties of the system. This is one of the requirements of gameful design (section 0). The method provided does aid the design decisions somewhat, but it can still be concluded that it is method is not in line with the principles of gameful design.

3.2.1.5 Morschheuser et al. (2017)

The authors conducted a literature search as well as interviews with 25 gamification experts in order to develop a method database. Based on these data, they proceeded to propose a method for gamification design. The method consists of seven steps, beginning with project preparation in which the situation is assessed and it is determined whether gamification is an applicable solution to be used. The requirements and objectives of the project are also determined. This is followed by analysis, where the users and the context are thoroughly analysed and personas are created. In the ideation and design steps, ideas for the actual gamification are brainstormed, prototyped and tested. Then a design is implemented and evaluated. Finally, in the seventh step, the system is monitored after being launched and the collected data are used to improve it where necessary.

The method proposed is thorough and well-supported. Once developed it was evaluated through a series of interviews with the same experts as before. It is similar to the method proposed by Deterding (2015) in that it advocates for gathering data about the intended user group and it also includes an ideation phase. There are two main differences between the two methods. Firstly, the inclusion of the design lenses by Deterding (2015) aid brainstorming and make the design process easier. Secondly, the method by Deterding (2015) is more practically-tested.

The frameworks discussed above are briefly summarised and compared in Table 7.

Study	**Name of framework**	**Description of framework**	**Theoretical foundations**
AlMarshedi et al. (2015)	Framework for Sustainable Gamification Impact (SGI)	A framework that aims to improve the sustainability of gamification by focusing on intrinsic motivation.	Flow (Csikszentmihalyi 1990); self-determination theory (Ryan & Deci 2017); Pink's drive motivation elements (Pink 2009).
Deterding (2015)	The Lens of Intrinsic Skill Atoms	A method for gameful design used to identify challenges inherent in a user's goal pursuit and iteratively prototype in order to rebuild these challenges so that they afford motivation and enjoyment.	Self-determination theory (Ryan & Deci 2017); design lenses (Schell 2008); skill atoms (Cook 2007); intrinsic integration (Kafai et al. 1998:160).
Kotini and Tzelepi (2015)	A Gamification-Based Framework for Developing Learning Activities of Computational Thinking	A student-centred framework that can be used to develop activities for computational thinking by combining gamification elements with constructivist learning principles.	Constructivist learning principles; gamification elements; computational thinking skills.

Study	Name of framework	Description of framework	Theoretical foundations
Marache-Francisco and Brangier (2013)	Design Process for Gamification	A method that guides the design of gamification systems based on human-computer interaction principles and gamification elements.	Human-computer interaction principles.
Morschheuser et al. (2017)	A Method for Designing Gamification	A method for gamification design based on the evaluation of existing gamification methods as well as interviews with experts.	Based on the frameworks developed by other authors.

Table 7 - Gamification frameworks compared

Based on the comparison of the gamification frameworks, the following section describes the method chosen.

3.2.1.6 Chosen framework and reasons

The method that will be followed by this study is the Lens of Intrinsic Skill Atoms provided by Deterding (2015). There are various reasons for choosing this method. Firstly, it is the only framework based on gameful design (as opposed to gamification) which means it does not approach the gamification process with the idea of adding game elements to a context. Secondly, it has the firmest foundation in game studies literature, which is the foundation of this dissertation. Finally, it provides the most practical guidance on applying gameful design to a situation through its appendices of design lenses and skill atoms. The chosen method will be described in more detail below.

3.2.1.7 The Lens of Intrinsic Skill Atoms

The method is based on three concepts: design lenses, skill atoms and intrinsic integration.

The concept of design lenses was developed by Schell (2008) as a means of providing a game designer with multiple perspectives on their design. Schell (2008:xl) describes them as "questions you should ask yourself about your design". Practically, a lens consists of a short, memorable

name; a brief statement to explain the context of the lens; and a set of guiding questions that allow the designer to reframe their design from the perspective of the current lens. The lens is essentially a small, self-contained unit and it can therefore be transferred across domains, as demonstrated by Scott (2010), who developed a few lenses for interaction design based on those created by Schell (2008). The same was done by Deterding (2015) for this method. The lenses were converted into motivational design lenses that are organised by motives.

The method is also based on the concept of intrinsic integration (section 0). It is concerned with identifying the challenges inherent in the user's use of the system and modifying these to be motivating and enjoyable. This is crucial in gameful design because challenges provide opportunities for motivating experiences, but it is important that these experiences are based on the user's inherent challenges within the system, rather than simply adding additional irrelevant challenges to the system.

Cook (2007) introduced the idea of skill atoms as self-contained feedback loops that can be used to describe how a player gains a skill in a game. The atom contains four elements. The player begins the process by performing an action in the game, for example, pushing a red button next to a door. The game responds with the simulation element which updates the game state based on the action of the player. In this case, the door opens. The feedback element communicates this change in state to the player using visual, auditory or some other means of feedback. Finally, in the modelling step, the player uses the feedback provided to update their mental model of the game. By performing the same action multiple times, a player is able to learn how to use it in order to progress in the game, and thus master a new skill. In short, Cook's (2007) skill atom describes how the action-feedback loops in a game enable a player to learn a new skill. Deterding (2015:314) has taken this concept and modified it slightly so that it is applicable for designers to use and apply to structural elements of a system, rather than process elements of a game. The result is shown in Figure 8.

To further describe Figure 8, the skill atom is built around a central challenge which is directly related to the user's goal within the system. This is what intrinsic integration is about – basing the challenges within the system around the user's inherent goal. The user has some motivation which is causing them to interact with the system in the attempt to achieve their goal. Often, this motivation is driven by the psychological need for competence, which causes the user to seek out challenges relative to their skill level. Actions and objects within the system provide the means for the user to pursue this goal by allowing them to interact with the system. These actions and objects are constrained by the rules within the system itself. Finally, as the user takes actions in

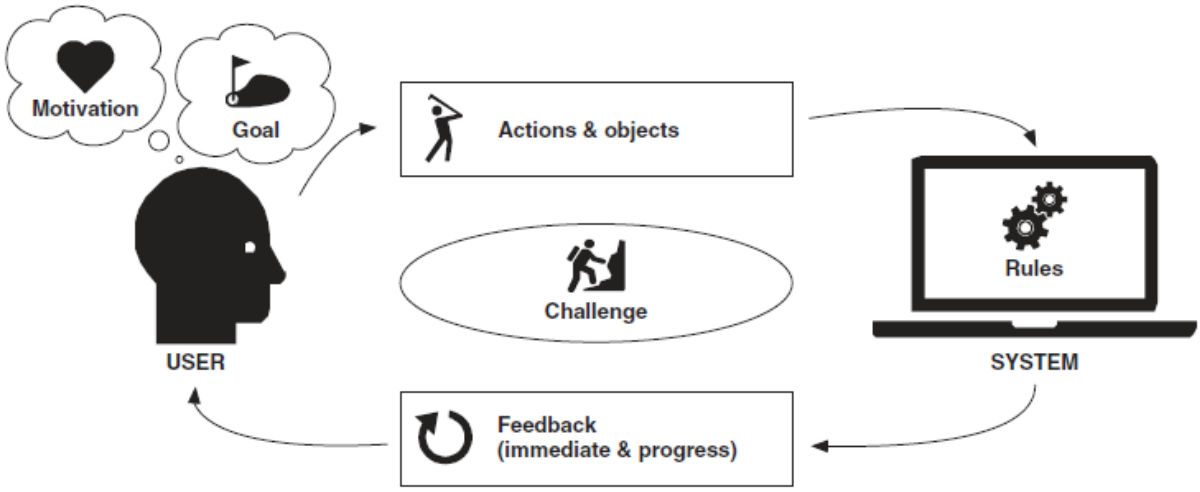

Figure 8 - The schematic of a skill atom as described by Deterding (2015:314)

order to achieve their goal and overcome the challenge, the system provides them with feedback – immediate feedback on each action and progress feedback on their accumulated progress within the system – which in turn should enhance their motivation. The loop continues until the user has overcome the challenge and achieved the goal, which results in a motivating experience.

Deterding (2015:315) has combined this revised version of a skill atom with the concepts of intrinsic integration and design lenses to create a single lens called the "Lens of Intrinsic Skill Atoms". This is the core component of the method. The lens aims to guide the design of a gameful system by focusing on the skill-based challenges that are inherent in the user's interaction with the system. "A gameful system supports the user's needs by both (a) directly facilitating [the skill-based challenges'] attainment, removing all extraneous challenges, and (b) restructuring remaining inherent challenges into nested, interlinked feedback loops of goals, actions, objects, rules, and feedback that afford motivating experiences." (Deterding 2015:315)

3.2.2 Applying the Lens of Intrinsic Skill Atoms method

Deterding (2015:316) defines five steps in the process of the above-mentioned gameful design method. Each of these steps is further divided into additional sub-steps. The following section will describe each step and then describe how the step was applied in this study in order to produce the gameful system.

3.2.2.1 Step 1: Strategy

The strategy step outlines the goals and parameters of the project. The first sub-step requires the designer to define what the target outcome of the project is and how it will be measured.

Specifically, it is important to state here how to quantify this outcome. The second sub-step focuses on defining the target audience and the activity of theirs which will be the focus of the intervention. It might be necessary to perform data gathering functions in order to properly define these concepts in terms of the project in question. Finally, in the third sub-step, the constraints and requirements of the project are identified. This is an important part of any interaction design project (Rogers, Sharp & Preece 2015:352–388)

A. Define target outcome and metrics

The target outcome of the website is to satisfy the three psychological needs of the students. In satisfying these needs, the intrinsic motivation of the students towards the website will be sustained and their level in internalisation will also improve. This outcome is shown visually by the logic model described in section 3.1.2.2.3.5.

B. Define target audience and activity

The target audience was identified as students at a higher education institute in order to align with the goals of the study. To narrow the focus, students at the University of Pretoria were targeted. This made the process easier because the researcher is affiliated with that university. First-year undergraduate students were chosen because they are likely to have the smallest workload which makes them more likely to be willing and have time to engage with the website. The degree with which the researcher is associated is the (BIS) Multimedia degree and therefore there were two first-year modules from which to choose.

For the design of the pilot system, the module of IMY 120 was chosen. This is because the content taught in the module required students to practice using the software outside of class time and this was often neglected. This module taught content-creation programs which can be used to create multimedia products. The activity to be gamified was therefore the use of Adobe Photoshop, Adobe Animate and Adobe Audition to create content.

The results from the pilot study showed that the students did not engage with the website as much as desired because they felt that the gameful parts of the website, specifically the quests, placed constraints on their creativity. They preferred to choose their own tasks in the content-creation software. For example, one quest on the website required the students to use a photo provided and to edit it in Photoshop. In the focus groups following the pilot study, a student explained that he did not like being told which image to use and what he had to do as he found the provided image boring.

As a result, following the pilot study, parts of the website were redesigned so that it could be used in the other first-year module instead. This module, IMY 110, taught basic markup languages for web development. This was the final version of the website which was ultimately tested and documented in the case study. This module was found to be more suited to gameful design because there is less creativity and subjectivity involved in learning markup languages compared to learning content-creation programs.

C. Identify constraints and requirements

Constraints and requirements on the website are described in section 3.2.3.1.

3.2.2.2 Step 2: Research

The research step involves understanding the activities, needs and motivations of the users so as to determine whether gameful design is applicable to the situation.

A. Identify user needs, motivations, hurdles

This step requires identifying the needs, motivations and hurdles of the users. The method recommends doing this through the use of laddering interviews. This study made use of questionnaires to elicit the needs of the students as it made it possible to gather data from a larger sample group in a shorter period of time. These data were gathered from the questionnaires administered to the pilot study group at the end of the period of implementation. They were used to determine the needs and motivations of undergraduate students in a first-year module. From these needs and motivations, the hurdles of the students were inferred.

Needs and motivations

Students in a first-year undergraduate module have the need to learn the content of the module well. The primary motivation for this need is to ensure success in the rest of the degree. The reasons for this motivation are:

- Securing future employment opportunities.
- Placing personal value on having a good education.
- Self-pride and feelings of self-importance.

An additional supplementary motivation for learning the content of the module well is because the activities in the module are satisfying and enjoyable.

Hurdles

- Fear of failure resulting from the pressure of the reasons for desiring success mentioned above.
- Difficulty grasping the content taught in the module which directly affects the need to learn the content properly as shown above.

From these data it is possible to see that that the primary need of a first-year undergraduate student is to do well in the module in question. Since both the modules (IMY 120 and IMY 110) are based on practical concepts which require practice to be mastered, gameful design will be a helpful addition because it will provide the motivation and interface in order to engage in this practice.

B. Determine gameful design fit

Gameful design can be considered an effective strategy for the case in question if the following four questions can be answered in the positive (Deterding 2015:317):

1. **Does the activity connect to an actual user need?**

Yes. It connects to the need to learn and understand the content. Specifically, the need is to learn to use the content-creation programs or to learn markup languages for web development. More broadly, the user need is to do well in the module which requires an understanding of the content.

2. Is lacking motivation a central issue or opportunity?

Yes. Students lack the motivation to practice the work they have been taught outside of class time. This means that they do not understand the concepts as thoroughly as they should.

3. Does the target activity involve an inherent challenge with a learnable skill?

Yes. The activity is found within an educational context which means that there are numerous skills to be learnt. The inherent challenge involved is that of mastering the course content.

4. Is affording experiences of competence the most effective and efficient way of improving motivation?

Yes. Competence is important in an educational setting since students are constantly faced with challenges. Satisfying this need for competence will improve the motivation of the student.

3.2.2.3 Step 3: Synthesis

In this step, for each targeted activity, the motivations and inherent skill-based challenges are identified.

The details of the implementation of this step are covered in chapter 4.

3.2.2.4 Step 4: Ideation

This step involves brainstorming ideas, prioritising and storyboarding these ideas and refining them using the design lenses provided with the framework. This step was implemented in conjunction with step 5 below and will be discussed in the following section.

3.2.2.5 Step 5: Iterative Prototyping

This step involves creating prototypes of the ideas from step 4, testing and reworking them until the desired result is achieved.

Step 4 was implemented in a slightly modified manner since the design of the system was done by one person instead of a team. First, ideas were developed and sketched. Then they were refined using the design lenses. During this step, the requirements of the system were also taken into account. Once a fairly-well refined idea had been established, smaller parts of it (such as the concept of a quest) were tested. This was done through informal user testing by presenting colleagues also familiar with game design with prototypes of the small section to be tested and receiving feedback on the interaction.

The majority of the testing took place during the pilot study, in which the website was implemented in the IMY 120 2016 module and used by students throughout the semester. Problems were fixed as they surfaced, and at the end of the semester students completed an electronic survey. This was followed by a focus group in which additional issues were explored. The primary result of the pilot test was the choice to change the module of implementation to IMY 110 2017. This was done because feedback showed that students did not like to be told how to practice using the content-creation programs. This led to the conclusion that the activity

chosen to be gamified (step 1) was not suitable. As a result, the module of markup languages was chosen instead because it is also a first-year module, but it includes less opportunity for creativity and therefore will not have the same problem as the IMY 120 module.

The ideation and prototyping steps involved making various design decisions. These decisions were based on the theory presented in chapter 2. They are discussed in detail in chapter 4.

3.2.3 Software development life cycle model

It is necessary to discuss the software development model that was used to design the website since it can be considered a fairly large development project. A software development life cycle (SDLC) is a framework of the stages involved in producing a software product (Ruparelia 2010:8). It differs from a methodology in that it describes what to do while the latter describes how to do it (Ruparelia 2010:8).

The model chosen for this project was the waterfall model, as modified by Royce (1987). Figure 9 shows this model.

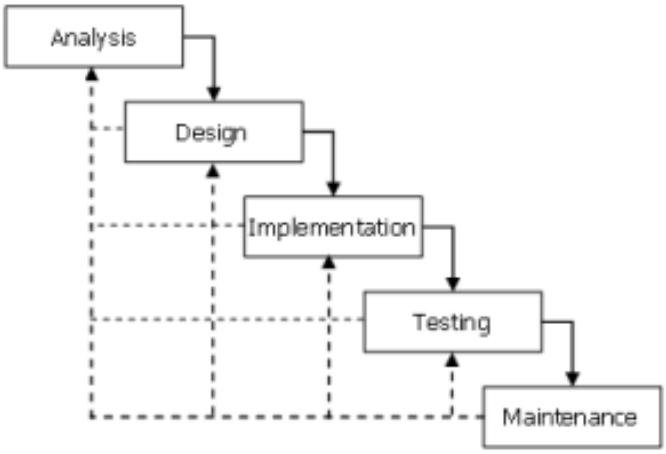

Figure 9 - The waterfall software development life cycle model (Bassil 2012)

The first version of this model, presented by Benington (1983:305), did not include the dashed arrows that allow the steps to be revisited at a later stage. This made a rather inflexible model which is why it was revised by Royce (1987).

This was the model of choice for the development of the website because of its flexible nature. Since all steps of the development life cycle were carried out by one person, this level of flexibility was necessary to ensure a working website was produced within the required time frame.

The steps of the model are described in more detail in the following sections.

3.2.3.1 Analysis

In this phase, the requirements for the software product are explicitly defined (Bassil 2012). Requirements can be functional or non-functional. Functional requirements state what the system should do, while non-functional requirements are constraints on the system and the development (Rogers, Sharp & Preece 2015:356).

The requirements for the gameful website are articulated below.

Functional requirements

The website should:

- Allow students to download lecture notes.
- Allow each student to view their own marks.
- Keep track of the marks of all the students.
- Provide access to practicals, assignments and the project as well as make provision for students to upload their work.
- Allow the lecturer to make announcements and students to view those announcements.
- Provide students with gameful ways to practice their skills relating to the module (IMY 110).
- Allow students to customise their avatars.
- Communicate the story of the fictional character.
- Provide a forum on which students can communicate.

Non-functional requirements:

- Each student alone should have access to their own profile.
- All passwords must be encrypted.
- The website must be accessible on the internet, not only on an internal server.
- All module information should be easily visible and accessible.

3.2.3.2 Design

During this phase, the software product is thoroughly planned (Bassil 2012).

This part of the project was guided by the framework of Deterding (2015) that was described in section 3.2.2.

3.2.3.3 Implementation

This is the phase in which the actual coding of the software takes place so that the requirements and designs are realised (Bassil 2012).

This phase took place over a period of three months and was completed by one developer (the researcher).

3.2.3.4 Testing

In the testing phase, the product is checked to determine whether it meets the original requirements and achieves the intended goal (Bassil 2012).

Testing of the website took place both in conjunction with the implementation (parts of the website were tested as they were finished) as well as in the form of a pilot test where the website was implemented in a first-year module, IMY 120 2016.

3.2.3.5 Maintenance

This phase takes place after the product has been deployed. It is done to refine the output of the product and correct any errors which may have arisen (Bassil 2012)

Maintenance on the website took place during the pilot test as errors were uncovered. Additionally, upon completion of the pilot test, the website was altered based on the results of the data gathering.

3.3 Summary of chapter 3

This chapter began with a discussion about the case study research method used in this study and how this method was implemented. It was determined that an embedded, single-case design was used. The case was delineated as "a gamified website implemented in a higher education setting". The embedded units of analysis were direct and indirect interactions with the website. Data were gathered in four ways – archival records in the form of database data and Google Analytics on the website; direct observation made by the lecturer in the course; questionnaires and focus groups. A logic model in three parts was developed to visually represent the effect of the website. First, an outcomes chain logic model and a realist matrix were used to show the effect and the situations in which the website would be more and less effective. Then a narrative representation was provided in order to summarise the previous two logic models into one cohesive paragraph.

Following this, the design of the gameful system referred to as the case was discussed. A gameful design method proposed by Deterding (2015) was chosen to guide the design of the system and a

waterfall software development life cycle model was used the guide the development. The following chapter discusses the design of the system in more detail.

4. Chapter 4 – System design and development

The previous chapter detailed the research methodology of this study. It also discussed the design methods used in the development of the gameful website. This chapter provides the detail of the design of the website.

The chapter consists of three main sections. The first section discusses the design of the pilot website from the perspective of the design method, Lens of Intrinsic Skill Atoms, described in section 3.2.1.7. The second section describes the pilot study and its results, and the third section describes the changes made to the pilot system to result in the final system that was implemented in the IMY 110 2017 module.

Throughout the chapter, usernames from the website have been blurred out (in screenshots) to preserve the anonymity of the users.

In discussing the design of the gameful website using the Lens of Intrinsic Skill Atoms method, referenced will be made to the design lenses provided in the method. These lenses are listed and described in Table 8.

	Lens name	Description
	Feedback lenses	
1	Immediate	To reduce friction and not break flow, good feedback occurs right where and when the action occurs.
2	Juicy	To foster the experience of competence, good feedback is juicy.
3	Actionable	To foster learning and competence, good feedback tells users how successful they were - and how to improve.
4	Appeal to motivations	Good feedback elicits the emotions and motivations that drive the activity.
5	Glanceable	To not break flow, good feedback does not get in the way of taking the next action.
6	Varied	To remain interesting, good feedback varies without being unlearnably or confusingly inconsistent.
7	Surprising	To stoke curiosity, good feedback is surprising.
8	Graspable progress	Good feedback makes the current status and progress of the user graspable.
	Action and object lenses	
9	Bite sized	Well-designed actions are split into an immediately doable size that gives the good feeling of having accomplished something.
10	Interesting choices	Well-designed actions provide only interesting choices.
11	Limited choice	Well-designed actions do not overwhelm users with too much choice.
12	Micro flow	Well-designed actions form an uninterrupted loop of immediate action and feedback.
13	Small pieces, loosely joined	Resources inviting exploration and creativity are like Lego bricks: they can be easily assembled, reassembled, and disassembled.
14	Expressive objects	With good resources, users can express who they are, want to be, and belong to.
15	Under-determination	To invite exploration and creativity, good resources have no clearly prescribed space of possible uses and configurations.
16	Sensual objects	With good resources, exploring their (pseudo-)physical properties is a joy.

	Lens name	Description
	Goal and motivation lenses	
17	Interim goals	To support a sense of progress and direction, structure the user's path with clear interim goals.
18	Viral calls to action	Good games use A's actions to call B to action – and vice versa.
19	Next best action	To maintain flow, good goals suggest the next best actions.
20	Intrinsic rewards	To avoid coercing users or devaluing the activity, rewards should support intrinsic needs.
21	Secrets	Good calls to action stoke curiosity by hinting at something hidden.
22	Templates	Things to adapt are easy invitations that ease over the fear of the blank page.
23	Traces of others	Traces of what other people did are inspiring invitations to follow them.
	Challenge Lenses	
24	Scaffolded complexity	To neither bore nor frustrate, good challenges grow with the user's skills.
25	Varied challenge	Good challenges vary to give the user experiences of mastery and not become boring.
26	Onboarding	Good challenges make learning the system an intentional part of the experience for newcomers.

Table 8 - The design lenses provided in the Lens of Intrinsic Skill Atoms method (Deterding (2015))

4.1 Overarching design decisions

The website implemented in the module was intended to replace the learning management system of Blackboard which is the default system used by the University of Pretoria. This meant that it needed similar functions provided by Blackboard. This included allowing the lecturer to post announcements to students, as well as providing students with access to their marks, class notes and the ability to upload their compulsory module tasks such as assignments and practicals. These components of the website were not gameful and they were the only parts of the website which were compulsory for the students to interact with in order to pass the module. The rest of this chapter focuses on the gameful, optional parts of the website.

The focus of the gameful parts of the website was the satisfaction of the three basic needs – autonomy, competence and relatedness – in order to improve intrinsic motivation. For this reason, no extrinsic rewards were used. Examples of extrinsic rewards include anything where course credit is given for engagement in the gameful section of the website. This part of the website was completely separate from the official credit of the module. This therefore meant that the gameful parts of the website were optional to the students. They were not required to engage with them in order to meet the requirements of the module.

The general style of the website focused on a clean, simplistic design. The purpose of this was to ensure that the layout and style did not detract the user's attention from the important gameful and even non-gameful module-specific elements. The visual style of the gameful elements was colourful and comical to engender a playful aesthetic. In addition, the various gameful elements (achievements, titles, shop items, monsters) were given comical names to further contribute to the playful aesthetic. These names and descriptions (in the cases of the monsters) were also intended to stimulate the interest of the users to continue using the website in order to discover further snippets of comedy.

4.2 The pilot website

The website was designed according to the Lens of Intrinsic Skill Atoms method. This section describes the design process and the reasoning behind the decisions made. For clarity, the site map of the website is shown in Figure 10. Each numbered section of the site map is discussed in detail below.

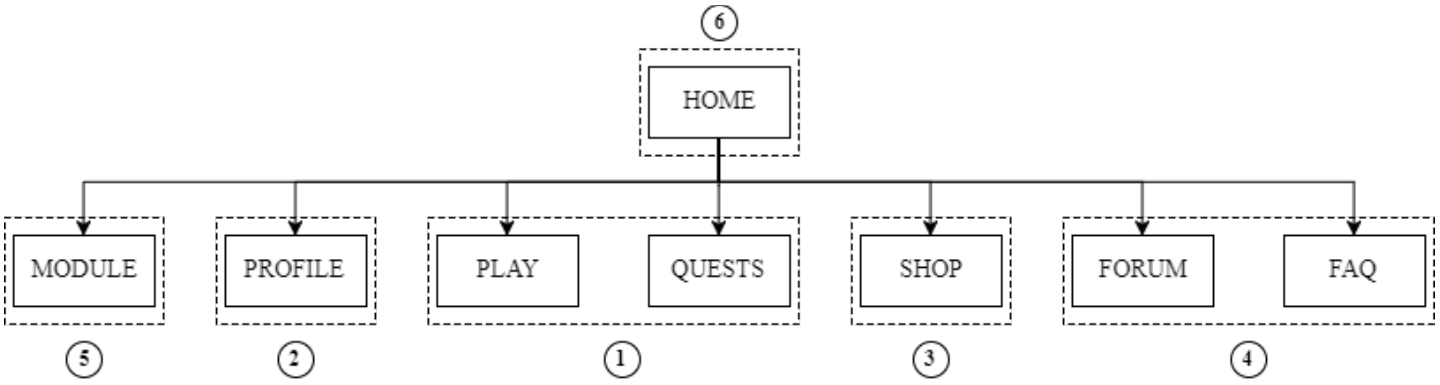

Figure 10 - The site map of the pilot website

4.2.1 Section 1: Play and Quests

This section of the website represented the main gameful features that were implemented. These features centred around the maps, which could be found on the Play page.

4.2.1.1 The maps

The maps were the main way in which the users had access to the optional gameful features of the website. Each map consisted of a grid of blocks which were initially blue, but as the user uncovered them, they would reveal pathways which connected to each other. Users could move their avatar (a blue game piece) around the map by using arrow keys or the mouse. Each movement to a block had a cost of one activity point (AP) (section 4.2.1.1.2). This was the currency of the website. As users moved around the map, they uncovered monsters, quests, treasure in the form of AP and hidden shop items. Figure 11 shows one map as an example.

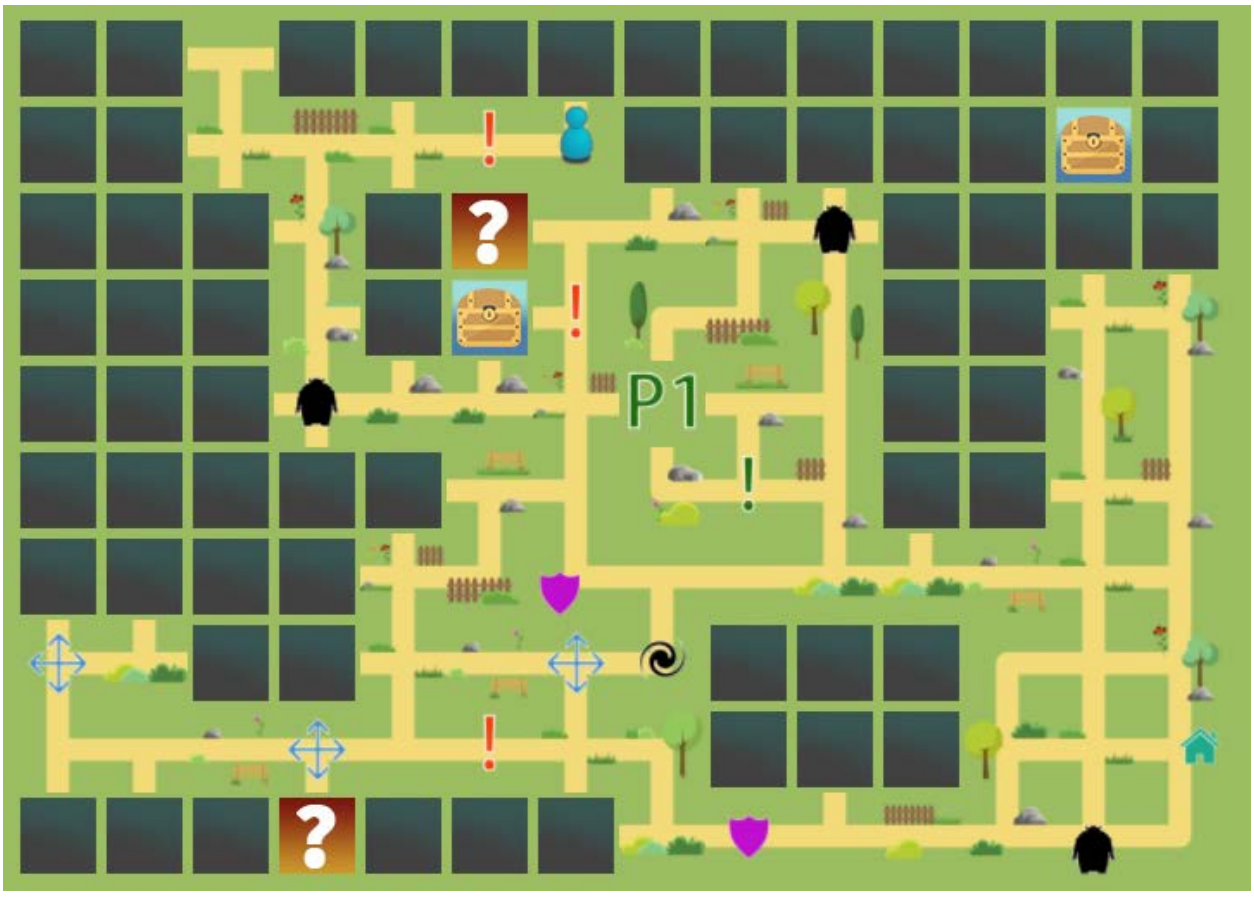

Figure 11 - A map from the pilot website

The map itself was designed to be a type of task-inherent feedback (Ryan & Deci 2017:154) which means that the feedback provided by the map itself as it was being explored is a type of feedback which is gratifying and helps to sustain interest.

Table 9 provides a key for the elements that can be found on the map along with a description of each.

Image	Name	Description
	Completed quest	A quest which has successfully been completed by the user.
	Defeated monster	A monster which has successfully been defeated by the user.
	Map starting point	The point where the user's avatar starts on the map when the map is accessed for the first time. This differs for each user as each user's map is randomly generated.
	Practical or assignment block	On this block a user can access the week's practical and/or assignment (compulsory parts of the module). If the text is green, the item has been completed. If the text is red, the item has not yet been finished. A user can teleport to this block for free and upon doing so, the directly-surrounding blocks are revealed.
	Teleport	A user can use the teleport function to move to any teleport block for free (there is no AP (section 4.2.1.1.2) cost to do this). This speeds up movement on the map.
	Treasure	This block reveals a small number of AP which are added to the user's current AP.
	Uncompleted quest	A quest which has been uncovered but not completed. When the user's avatar is on this block, the user can view the details of the quest. If they are not on the block, the quest details can be viewed on the Quest page.

Image	Name	Description
	Undefeated monster	A monster which has been uncovered, but not defeated. The monster can be fought if the user's avatar is on this block.
	User avatar	The user's avatar token that is moved around the map by the user. It can only move along the pathways, which are revealed as it moves onto a hidden (blue) block.
	Wildcard	This block reveals an unexpected block which can be one of the following: free AP, shop item, monster or quest. This is randomised when the map is created.
	Wormhole	An entrance to a smaller map. Wormholes are revealed when a quest has successfully been completed and that quest has additional follow-up quests. The user can teleport to the wormhole block to access the smaller map.

Table 9 - The elements on the map (pilot website)

Wormhole blocks were uncovered when quests (section 4.2.1.1.4) which had follow-up quests were completed. Teleporting to a wormhole block took the user to a smaller map (called a wormhole map) with more difficult quests (section 4.2.1.1.4) and greater AP rewards (section 4.2.1.1.1.1). Users were given access to a new map each week, and each map had its own wormhole maps, quests and monsters.

The maps were generated randomly for each user which meant that no two users had the same map. This prevented users from comparing their maps and finding out where elements could be found.

4.2.1.1.1.1 Map design

This section describes the design choices made with regards to the map.

AP cost for each block movement: Moving to each block in the map, whether covered or uncovered, cost 1 AP (section 4.2.1.1.2) each time. In order to make it important enough to incentivise the quests and fighting the monsters, it was necessary to give AP a high value by adding a cost to map movement. This also meant that the maps would not be uncovered in a matter of minutes, but that they would require thought and restraint from the user. This is an implementation of the limited choice lens (Table 8, 11) which prevents users from being overwhelmed by too many possible actions. This is also described as freedom to choose (section

2.4.4.2.4) because it provides users with a moderate amount of meaningful options in order to support their autonomy.

One map per week: A large number of quests were developed for the website. It was necessary not only to divide the quests according to the order in which the content was presented in the module, but also to provide some means of scaffolding (section 0). This would allow the users to gradually encounter more difficult quests as their skill level in the content-creation programs grew. This would prevent them from encountering a difficult quest in the beginning of the semester and then becoming despondent. This is an example of the scaffolded complexity lens (Table 8, 24).

Wormholes and wormhole maps: The purpose of these maps was to separate the easier quests from the more difficult, complex ones. It meant that in order to reach a more difficult quest, the user first had to master the easier content. This is another example of scaffolded complexity (Table 8, 24).

Teleport blocks: These blocks were added to prevent users from becoming frustrated that they had to use a lot of AP to move from one side of the map to the other, especially if they wanted to access a specific block (such as a monster). Teleport blocks were intended to prevent players from feeling punished for exploring the map (if they needed to backtrack at any point) as this would harm autonomy.

Treasure blocks: Treasure blocks were added to the map to add additional motivation to navigate the map. The blocks were visible on the map and therefore a user would be able to move in their direction in order to uncover the AP that they would reward. The number of AP given was a random number between 1 and 10. This adds a small amount of uncertainty to the map exploration as a user would have to take a risk by spending AP to get to the treasure and it might not always pay off. This uncertainty serves to satisfy autonomy because it adds meaning to the actions of the user.

Wildcard blocks: Wildcard blocks, like treasure blocks, were also intended to add uncertainty to the map. Since they could reveal a number of different block types, the user would not know what to expect, but since the block was visible on the map, they could plan to move to it.

Practical and assignment blocks: Practical and assignment blocks were included on the map (but could also be accessed on the quest page) as an attempt to integrate the compulsory module activities (those directly related to course credit) with the optional gameful activities of the

website. This meant that whilst using the map to access an assignment block, a student's interest might be piqued enough to continue engaging with the map.

Key: The map page included a key (Figure 12) which indicated how many quests, monsters, teleports, treasure and wildcard blocks there were in total as well as how many of each they had already uncovered. This was intended as a form of feedback (section 2.4.4.2.2) which helps the user to keep track of how well they are doing. This would help to foster feelings of competence. This is also an implementation of the glanceable design lens (Table 8, 5) as well as graspable progress (Table 8, 8).

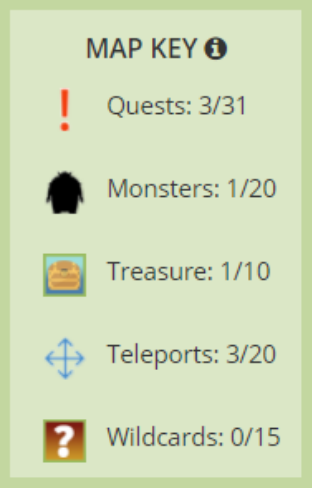

Figure 12 - The map key

Defeated monster blocks and completed quest blocks: These blocks were intended as a motivator to the user to allow them to see how many monsters they had defeated and how many quests they had completed. They were a type of progress feedback for a user to see how far they had progressed. This is based on the concept of glanceable feedback (Table 8, 5) which allows the user to quickly see how far they had come.

General map design: The design of the map itself was inspired by multiple design lenses. The lenses of micro flow (Table 8, 12) and sensual objects (Table 8, 16) were used to design the movement of the avatar around the map. The smooth interaction made it pleasing to use. The map is also an example of onboarding (Table 8, 26). This lens describes "creating a strong want in the user to start" (Table 8, 26) and the smooth, easy interaction of the map made this possible. The use of wildcard and treasure blocks, as well as hidden monsters, is an example of the secrets (Table 8, 21) lens.

4.2.1.1.2 AP

AP (activity points) were the driving force behind the gameful elements on the website. It was intended to add value to the available actions (quests, monsters, map movement) on the website and in doing so, give users a reason to carry out these actions. In this sense, it was a type of currency.

AP was an intrinsic reward (section 2.1.3.4) within the system, which meant that it had no value outside the website or in the real world. This was done to keep the system from giving the users extrinsic rewards such as course credit or deadline extensions, but rather to motivate them intrinsically using an internal system mechanism. This in turn allowed the system to remain within the boundaries of the study, which was focused on intrinsic motivation. In addition, the literature shows that extrinsic rewards do not lead to sustained behaviour (section 2.1.1.2.1.1) so this was avoided. From this perspective, AP is an implementation of the intrinsic reward lens (Table 8, 20).

Whilst it had no real-world value, AP could still be awarded outside the website during class time at the discretion of the lecturer. This made it possible to extend the boundaries of the gameful system beyond the limits of the website into the module as a whole.

Since points are considered one of the most common elements to add to a gamified system (section 2.3.2.3 and 0), it is necessary to explain why AP differs from the points used in other tertiary education gamification systems. An analysis of existing studies (section 0) reveals that points are used for three main reasons: to create a leaderboard of users (Cheong, Cheong & Filippou 2013; Paisley 2013), to allow for levels to be reached and to award course credit based on these levels (Goehle 2013; O'Donovan, Gain & Marais 2013; Schreuders & Butterfield 2016) and lastly, to give users feedback on their actions (Song, Ju & Xu 2017). In the case of using points for levels and extrinsic rewards, this has negative side effects as discussed above. In the case of using points to create a leaderboard, this can be classified as a performance-contingent reward (section 2.1.1.2.1.1) which could have negative side effects if it is viewed as controlling. A gamification education study conducted by Domínguez et al. (2013) revealed that not all students enjoyed the addition of a leaderboard to a system because they did not like the fact that others could see their progress. Finally, in the case of using points as feedback, this could be viewed as either controlling or informational (section 2.1.1.2.1.1), depending on the person.

A shortcoming evident in most of the studies examined in section 0 is that the points do not tie in to the system as a whole as intrinsic rewards. In the case of the system designed for this study,

AP is the driving force behind the behaviour of the users on the system because it enables actions. In doing so it causes the actions that it enables to become the reward for the player, instead of the AP itself being the reward. This is what Hallford and Hallford (2001) call a reward of facility because it enables users to do something that they were not able to do before. Rapp (2017:389–391) calls it an enabling reward and explains that it facilitates feelings of autonomy because it provides the user with more opportunities for action.

4.2.1.1.3 Monsters

The monsters that could be fought by the users took the form of quizzes on the course content. The format of the quiz is discussed in more detail in section 4.2.1.1.3.3. The primary need that the monster element aimed to satisfy was competence because it tested a user on their knowledge of the theory and provided them with feedback on their performance. The fact that the monsters were a core component of the system because they made it possible to earn AP, whilst at the same time directly testing the knowledge of the student, made them an implementation of intrinsic integration (section 0). This means that the main learning content of the system is an inherent part of the goal of the gameful implementation. This is one of the core components of the Lens of Intrinsic Skill Atoms method (section 3.2.1.7) as well as of gameful design in general (section 0). The monster element was also designed to be short so that users would not be discouraged to engage with the element because it would be time-consuming.

When a user positioned their avatar on an undefeated monster block on the map, they could choose to engage the monster in combat. Upon doing so, the battle preparation screen would be shown (Figure 13).

On this screen, the details about the monster were provided and the user was given the ability to use cards to help them in the battle. Cards (section 4.2.1.1.3.2) could be purchased at the shop (with AP as currency), which is detailed in section 4.2.3.

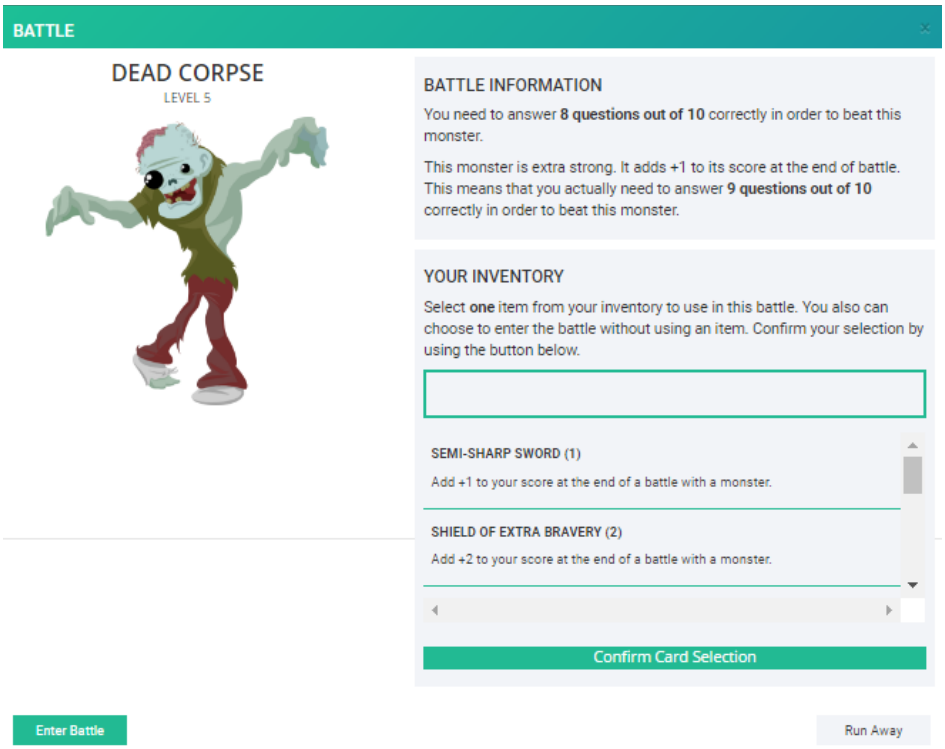

Figure 13 - The battle preparation screen (pilot website)

4.2.1.1.3.1 Monster details

The information given about the monster was their level and their special ability. This determined the difficulty of the monster. Table 10 shows the relation of the monster level to the number of questions that the user must answer correctly in order to beat the monster. The difficulty of the monster was incorporated to implement the varied challenge lens (Table 8, 25).

Monster level	Correct answers required	Number of questions
1	1	5
2	2	5
3	5	10
4	6	10
5	8	10
6	9	10
7	10	10

Table 10 - Monster level and corresponding difficulty of quiz (pilot website)

Monsters could also have one of three abilities or no ability at all. Table 11 describes these abilities.

Monster ability	Description on website	Explanation of ability
1	You may not use any cards against this monster. This includes the CONVENIENT CODING ERROR card, but it excludes the CROSSBOW OF UNFAIRNESS card.	A user could not use any cards to defeat this monster. This excluded the "Crossbow of Unfairness" card which doubled the reward provided if the monster is defeated.
2	This monster can sniff out sneaky ninjas. You may not sneak past it.	A user could not use the "Sneaky Ninja Santa Hat" against this monster. This card allowed the player to sneak past the monster and steal its treasure.
3	This monster is extra strong. It adds +1 to its score at the end of battle.	This ability increased the number of questions that the player had to answer correctly in order to beat the monster. Figure 13 shows an example of this ability.
4	This monster has no special abilities.	

Table 11 - Monster abilities (pilot website)

A total of 27 different monsters were designed, with varying distributions of levels and abilities. Each was represented by a comical image and a name. These monsters were added randomly to each map when the maps were generated.

4.2.1.1.3.2 Card details

Cards were essentially a form of power-up which could be purchased at the shop using AP. There were a few cards which could help in battles. Cards were added to the system to provide additional options for users so that they had some freedom in how to "fight" the monster. This was to foster feelings of autonomy. These cards are described in Table 13. A user could only use one card per battle.

4.2.1.1.3.3 Fighting the monster

When the user had chosen their card, they could start the battle. The battle screen (Figure 14) was displayed and the user had to begin answering questions.

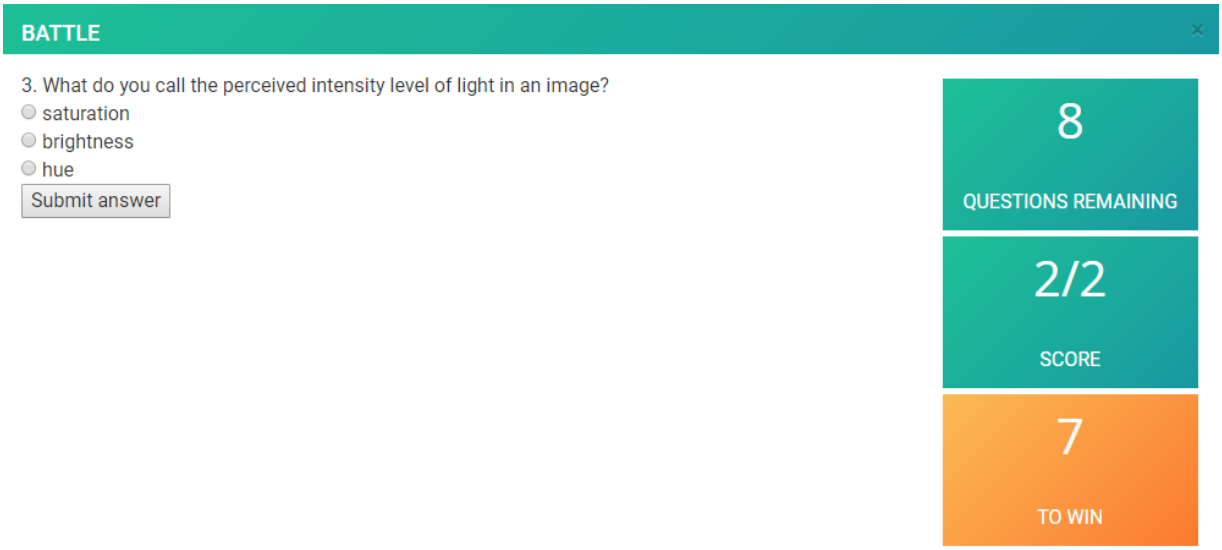

Figure 14 -The battle screen shown when fighting a monster (pilot website)

If the user answered a question incorrectly during the quiz, they were not shown the correct answer. This was to encourage them to try the quiz again after having discovered what the correct answer was. Their quiz score was tracked and when all the questions were complete, they were told what the outcome of the battle was based on their correct answers and the monster's level and abilities (Figure 15).

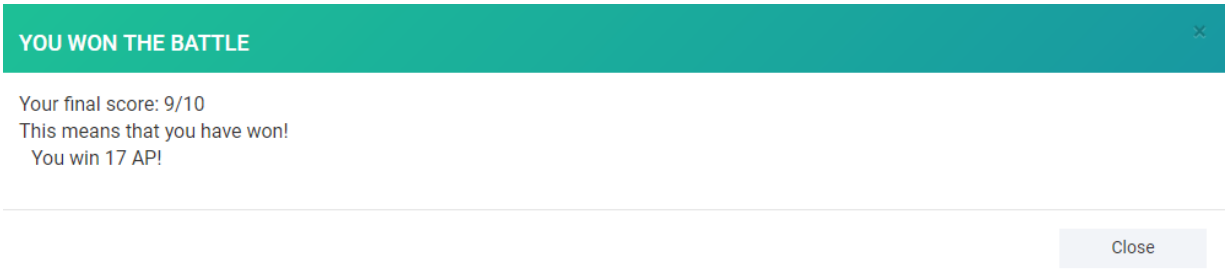

Figure 15 - The battle outcome screen (pilot website)

If the user beat the monster, they were awarded AP. Monsters that were stronger awarded more AP. If the user failed to beat the monster, nothing happened and they could try to fight it again immediately. This was allowed in order to implement the concept of freedom to fail (section 2.4.4.2.1) in order to prevent the user from feeling anxious about the outcome of the monster battle and to give them the chance to learn from their mistakes.

The quiz questions were randomly picked from a pool of questions on all content that had been taught in the module up to that point. This meant that students were only tested on content that they were expected to know at that point in the semester. This is an example of the scaffolded complexity design lens (Table 8, 24).

4.2.1.1.3.4 Monster design

Figure 16 shows the skill atom of a monster battle (quiz) adapted from the template provided by Deterding (2015). The purpose of adding this element to the website was to help the student practice their theory knowledge of the course content in a quick and easy way that is enjoyable.

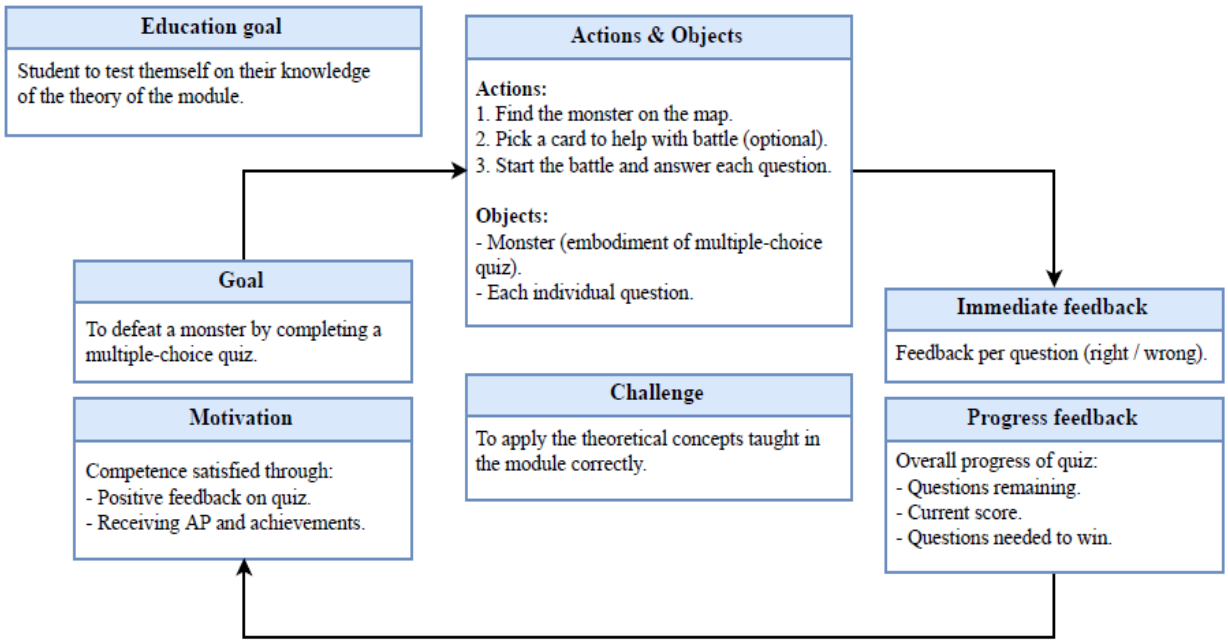

Figure 16 - The monster skill atom

Monster difficulty levels and abilities: This was used to vary the types of monsters that the students came across on the map in order to introduce an element of uncertainty which made the exploration of the map and fighting the monsters more interesting. This is an example of the varied challenge design lens (Table 8, 25). Uncertainty is an essential component in games, because without it players would not need to play the game in order to determine its outcome. Uncertainty satisfies autonomy (section 2.1.3.2) by providing meaning to the actions of the players.

Cards that affect the battle: The motivation behind allowing the user to use power-up cards in battle was to incentivise the collection of AP (since it was required in order to purchase the cards) as well as to make the monster battles more interesting and varied. This is an example of the interesting choices design lens (Table 8, 10).

No negative repercussions for losing the battle: This is an implementation of the concept of freedom to fail (section 2.4.4.2.1), which helps to foster feelings of competence.

Monster aesthetic design: To contribute to the enjoyment of the battles and to move away from simply quizzing the students on course content, the monsters were represented by colourful and comical images and names (section 4.1).

4.2.1.1.4 Quests

Quests were a way of testing the students on the practical components of the module theory. They required the student to follow a series of instructions in one of the relevant content-creation applications. The primary need which the quest component aimed to satisfy was competence. The quests, like the monsters, are also an implementation of intrinsic integration.

They were intended to be quick to complete in order to allow the students small opportunities to practice individual skills within the software applications. In order to keep them short, it was necessary to only focus on a single skill in each quest. This ties in to the concept of schemas in constructivist learning theories (section 0) which states that people learn by adding to what they already know. It also links to the concept of scaffolding (section 0) in which tasks are structured so that each one builds on what was learnt before (section 2.4.4.2.1).

Quests could be accessed from the map, and once they had been found on the map, they could also be found on the Quest page of the website. The reason why quests, unlike monsters, did not have to be found on the map when the user wanted to complete them was because it was necessary to provide the user with some way of collecting AP if they had used up theirs by moving around on the map. Otherwise the user would essentially get stuck and be unable to make progress in the system. Moving around on the map would cause the user to find quests which they could do later if they ran out of AP.

Upon opening a quest, the screenshot of which is shown in Figure 17, a user could view its instructions and download the file required (if any) to complete the quest.

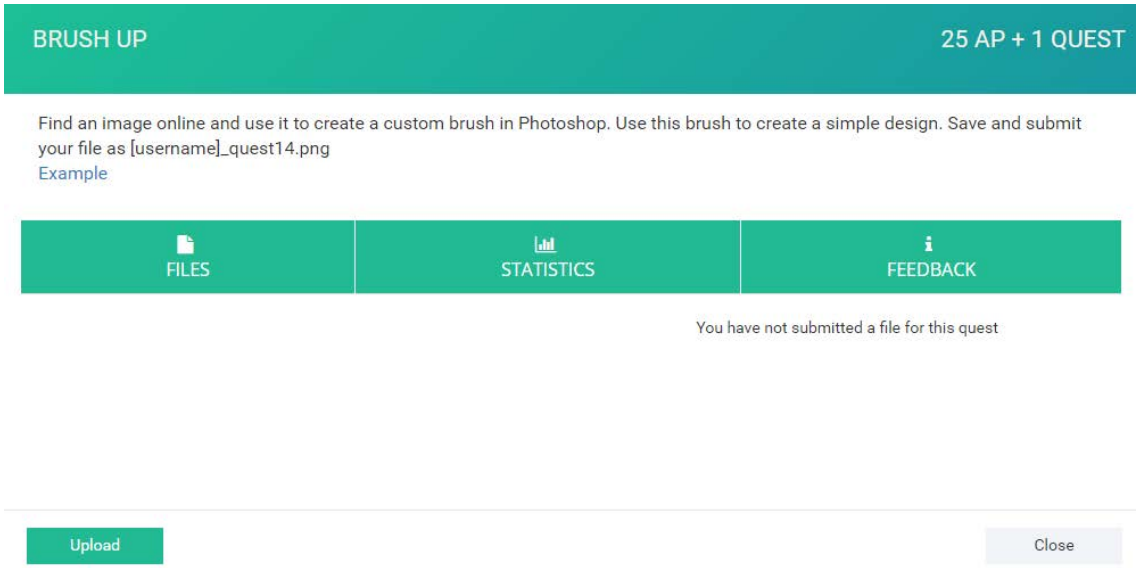

Figure 17 - A quest (pilot website)

In the top right-hand corner, the user could also see what the reward for the quest was. The user would then be required to follow the instructions and upload the completed file in the same place.

Once the quest had been submitted, the website administrator (who was also the module lecturer) could view it and mark it as correct or incorrect. If it was incorrect, feedback was provided as to why this was the case. Due to the nature of the course content, quests could not be automatically graded by the system (they involved performing editing or content-creation tasks on specialised software). This meant that the way in which the lecturer assessed the tasks needed to be easy and possible to do quickly. As a result, the interface allowed the lecturer to simply mark the quest as "correct" or "incorrect", and if it was incorrect, they could provide written feedback to the student as to why this was the case. The reason why quick feedback was important was to adhere to the principle of instant feedback (section 2.4.4.2.2). Since instant feedback was not possible in this case, the quest assessment system was streamlined to provide feedback as quickly as possible. Feedback, in this case, is also an implementation of the actionable design lens (Table 8, 3).

The user would receive a notification informing them of the outcome of the quest. If they had completed it correctly, they would be awarded the AP for it. If they had made a mistake, they would be given the feedback from the administrator and allowed to retry it. There was no limit to how many times a quest could be attempted. This is another example of freedom to fail.

147 quests were designed based on the course content. Most quests had an accompanying file which needed to be manipulated by the user in specialised software. The quests also represented a form of scaffolding (section 0) because completing a quest often unlocked a related, but more challenging quest on a wormhole map.

4.2.1.1.4.1 Quest design

Figure 18 shows the skill atom storyboard of a quest. The primary purpose of the quests was to encourage the users to practice the skills they had learnt since the content of the module was heavily dependent on practical application.

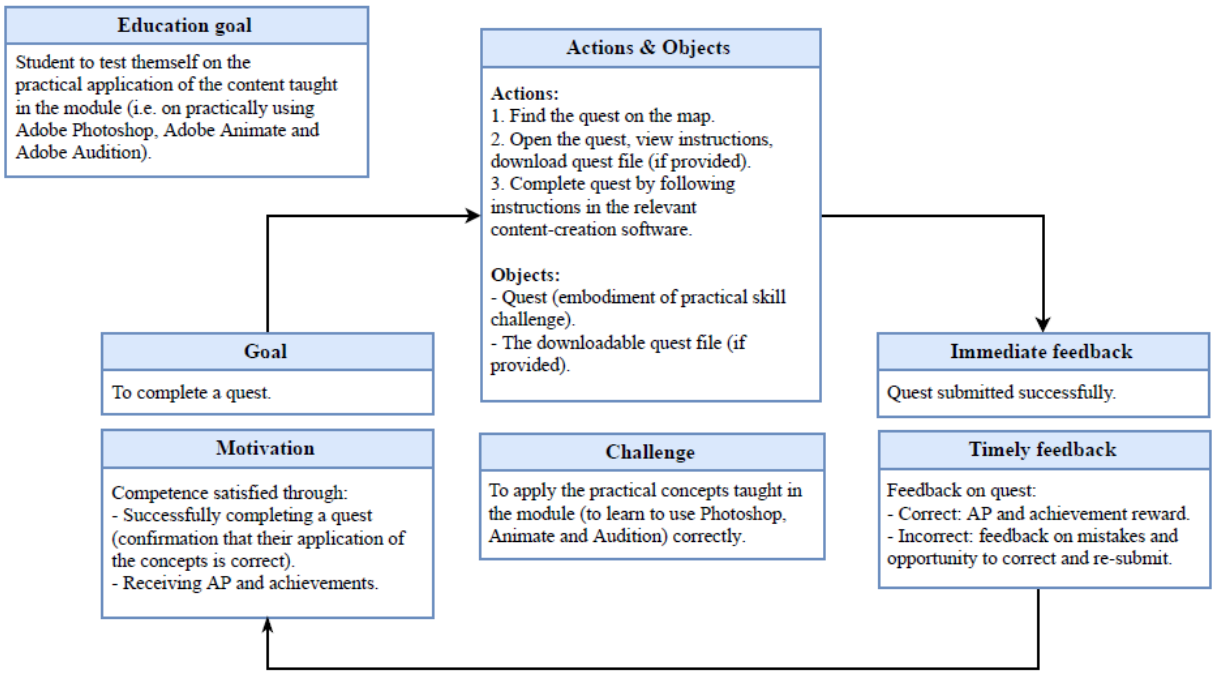

Figure 18 - The quest skill atom

Limiting the number of quests that the user had access to based on the week of the semester, is an example of limited choice (Table 8, 11). Additionally, the structure of the quest in a hierarchy uses the lens of interim goals (Table 8, 17) in order to break down complex content and make it more manageable.

4.2.1.2 The quests page

The quest page of the website provided the users with access to their practicals and assignments for the module; these were called compulsory quests. In addition, it also showed a list of active optional (gameful) quests which had been found on the map but had not yet been completed. This made it easy for a student to complete a quest without having to navigate across the map.

4.2.2 Section 2: Profile

The profile page was where a student could keep track of their own progress on the website. It had a number of different sections. Before describing the page and its sections, it is first necessary to discuss the use of achievements in the system.

4.2.2.1 Achievements

Achievements (also sometimes called badges) are widely used in gamification implementations; and, like points, they are one of the reasons why gamification is criticised for having a shallow view of games (section 0).

The majority of the studies reviewed in section 0 included some form of badges or achievements. These were provided to the users as a list along with a description of what the users needed to do in order to earn the achievement. This caused the achievement to function as a goal which directed the user's activity in a certain direction. When used in this way, achievements simply consist of an image and perhaps a witty name which represents a set of tasks that the user must complete.

The achievements used in this study were not shown to the users before they had earned them. They were awarded when the users had met certain requirements, and only then did the user know that they existed. This prevented the achievements from directly driving user activity and functioning as a to-do list. They were intended to allow users to customise their profiles so that they could show them off to their classmates. In this way, they could be viewed as rewards. This type of reward is classified as a reward of glory by Hallford and Hallford (2001) because in a game they have no impact on the gameplay, but they affect the experience of the player. In addition to being viewed as a reward, the achievements were also intended to facilitate feelings of competence by instilling a sense of accomplishment within the user.

By keeping the achievements hidden, the design lenses of secrets (Table 8, 21) and surprising (Table 8, 7) were used. It also meant that when a student saw another student's profile and was

unable to identify some of their achievements, they would be lead to ask what that student had done to earn the achievements. This encouraged conversation around the website.

Table 12 shows the full list of the achievements which could be earned on the pilot website. Some achievements also awarded the user with a title, which is described in more detail in the following section

Name	**Description**	**Title reward (if any)**
Setting The Bar	Complete 15 quests successfully	Young Padowan
On A Roll	Complete 45 quests successfully	
Overachiever	Complete 100 quests successfully	Dispenser of Wisdom
First Try	Complete 10 quests successfully on the first attempt	
This Is Sparta	Complete 30 quests successfully on the first attempt	
Photogenic	Complete all the Photoshop quests	Professor of Awesome
I Like To Move It, Move It	Complete all the Animate quests	Loremaster
Pitch Perfect	Complete all the Audition quests	
I Love The Smell Of AP In The Morning	Accumulate 100 AP	Collector of Fine AP
My Precious	Accumulate 500 AP	
Bill Gates	Accumulate 1000 AP	Bill Gates
War, It Never Changes	Defeat each kind of monster at least once	
I'm Seeing Double, Shoot Them Both	Defeat each kind of monster at least twice	

Name	Description	Title reward (if any)
Resistance Is Futile	Defeat 6 monsters	Slayer of Incompetent Minions
Cake Or Death	Defeat 15 monsters	
I Fear No Enemy	Defeat 40 monsters	The Titan
I'll Be Back	Defeat 80 monsters	Undisputed Battle Master
I Came, I Saw, I Conquered	Defeat 10 monsters without using any cards	
Epic Win	Answer all the questions correctly on 15 quizzes	
Albert Einstein	Answer all the questions correctly on 40 quizzes	
Look Ma, No Hands	Defeat 30 monsters without using any cards	The Undying
Fingers In A Lot Of Pies	Visit 20 different maps	
Let There Be Light	Explore 3 large maps completely	Pathfinder
Just Keep Swimming	Explore 6 large maps completely	
We're Not In Kansas Anymore	Explore 9 large maps completely	Maze Runner
The Cake Is A Lie	Explore 15 wormhole maps completely	Wilderness Explorer
Down The Rabbit Hole	Explore 30 wormhole maps completely	Almost Han Solo
Everything The Light Touches	Explore at least 70% of 3 large maps	
King of the Mountain	Explore at least 70% of 9 large maps	Marco Polo
Thanks For All The Fish	Explore 45 wormhole maps completely	Seeker of Knowledge
May The Force Be With You	Buy 5 cards from the shop	
Steel Wins Battles, Gold Wins Wars	Buy 10 cards from the shop	

Name	Description	Title reward (if any)
That Escalated Quickly	Buy 20 cards from the shop	Shopaholic
Stingy	Spend 50 AP at the shop	
Cash Dollar	Spend 100 AP at the shop	Great Spender of AP
Money Money Money	Spend 175 AP at the shop	
Failure To Communicate	Contribute to the forum 3 times	The Great Novice
I See What You Did There	Contribute to the forum 10 times	Honourable Speaker
The Answer Is 42	Contribute to the forum 25 times	
TLDR	Contribute to the forum 60 times	The Contributor

Table 12 - Achievements and titles that could be earned (pilot website)

4.2.2.2 Profile page design

The main parts of the profile page were the profile picture, achievement icons and title (Figure 19).

Figure 19 - A profile picture with achievement slots and a title (pilot website)

The profile image was customisable, with the user being able to upload their own image. The achievements and titles allowed a student to show off their success to others. Allowing the user to customise their profile was intended to foster feelings of autonomy (section 2.1.3.2). It was also intended to help foster feelings of relatedness by allowing students to talk to each other about their profile representations, thus making them aware that a larger community existed around

the website. This is also an example of the traces of others design lens (Table 8, 23) as well as the gamification design principle of social interaction (section 2.4.4.2.5).

When they received an achievement, a user could display it in one of the four rings underneath their profile image. Some achievements also awarded titles, which were displayed below the achievements. Achievements and titles could be changed at any time, and the list available depended on what the user had done on the website (how many achievements and titles they had earned).

At the start of the semester, none of the achievement rings were available. In order to unlock rings, students needed to fill progress bar that was displayed on the home page (Figure 25). This bar could be filled by exploring the maps. This meant that the user had to engage with the website in order to earn the right to display achievements. It did not tend to hinder users as those with achievements to display would generally have done enough exploration to unlock a ring in which to display them.

Additionally, users could also view a list of their own achievements (Figure 20) and a timeline of their activity on the website (Figure 21).

QUEST ACHIEVEMENTS		
NAME	ACHIEVEMENT	TITLE REWARD
15 Setting The Bar	Complete 15 quests successfully	Young Padowan
30 This Is Sparta	Complete 30 quests successfully on the first attempt	
EXPLORATION ACHIEVEMENTS		
NAME	ACHIEVEMENT	TITLE REWARD
45 Thanks For All The Fish	Explore 45 wormhole maps completely	Seeker of Knowledge
x20 Fingers In A Lot Of Pies	Visit 20 different maps	
GENERAL ACHIEVEMENTS		
NAME	ACHIEVEMENT	TITLE REWARD
50 Stingy	Spend 50 AP at the shop	
5 May The Force Be With You	Buy 5 cards from the shop	

Figure 20 - A list of achievements earned by a user, shown on the profile page

Users were also able to search for and view each other's profiles. A visitor to a profile could only view the timeline and statistics of another user. This was intended to foster a sense of community around the website by showing users that other users were also engaging with the website.

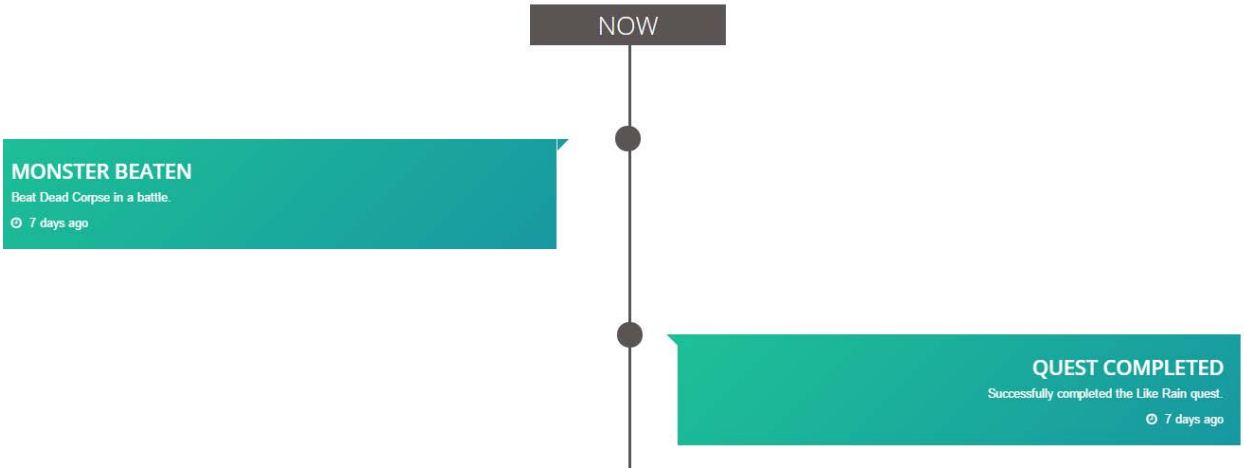

Figure 21 - The timeline on the profile page

This all served to provide the user with a sense of graspable progress (Table 8, 8) and intrinsic rewards (Table 8, 20) since they could see their own progress on the website.

4.2.3 Section 3: Shop

The shop page allowed users to spend AP to buy power-ups that would help them in other areas of the website. The shop was added to the website to add extra value to AP. The items in the shop would help the user to fight monsters and move around on the map. These items did require a trade-off as obtaining them cost AP so they would only be worthwhile if they helped the user to earn more AP than they cost. It was intended to create a desire in the user to spend their AP wisely in order to buy an item that might help them significantly.

The shop had two categories: battle and exploration (Figure 23 and Figure 22).

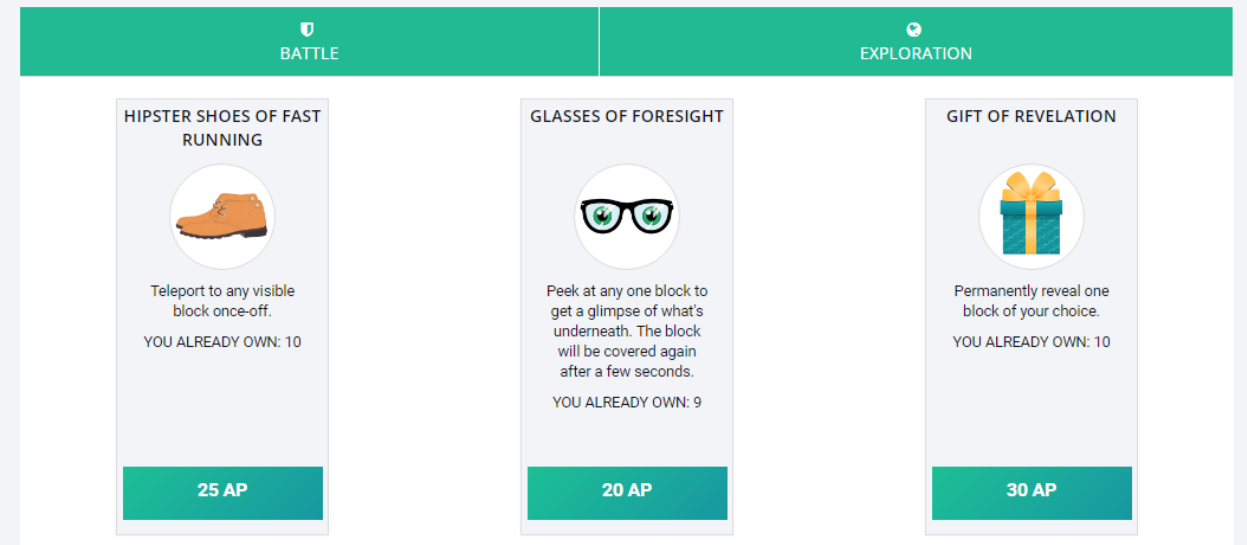

Figure 23 - The shop section selling exploration items (pilot website)

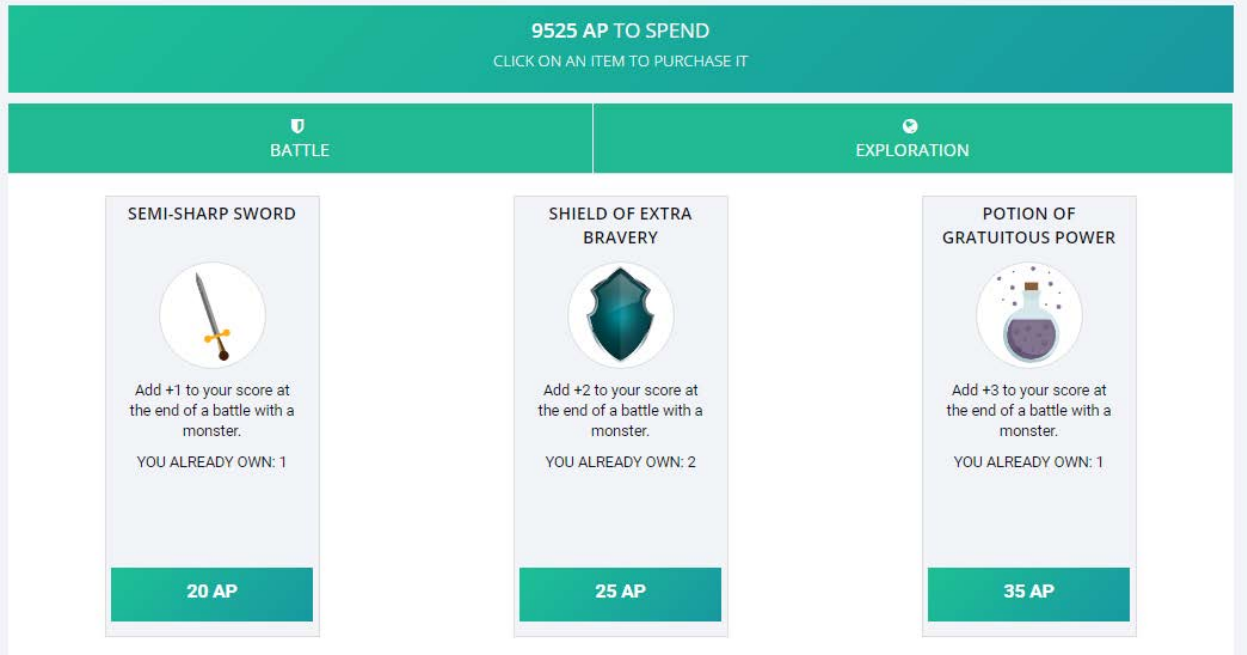

Figure 22 - The shop section selling battle items (pilot website)

The battle section contained items (referred to as cards – see section 4.2.1.1.3.2) which gave the user an advantage when fighting a monster. The exploration section contained cards which would make it slightly easier for a user to traverse the map. Since moving through the map was an expensive activity, these cards, when used wisely, would aid the user slightly.

Table 13 shows the items that could be purchased at the shop along with a description of each.

Item name	**Description**
Semi-Sharp Sword	Adds +1 to the user's score at the end of a battle with a monster.
Shield of Extra Bravery	Adds +2 to the user's score at the end of a battle with a monster.
Potion of Gratuitous Power	Adds +3 to the user's score at the end of a battle with a monster.
Crossbow of Unfairness	Doubles the treasure guarded by a monster. If the user loses the battle then they lose all the treasure.
Sneaky Ninja Santa Hat	Allows a user to sneak past a monster without confronting it to get its treasure. This means that they beat the monster without answering the questions.
Convenient Coding Error	Cancel out any abilities that a monster might have (see Table 11 for details on these abilities).
Hipster Shoes of Fast Running	Teleport to any visible block on the map once-off.
Glasses of Foresight	Peek at any one block to get a glimpse of what's underneath. The block will be covered again after a few seconds.
Gift of Revelation	Permanently reveal one block of the user's choice.

Table 13 - The shop items and descriptions (pilot website)

4.2.4 Section 4: Forum and FAQ

The forum page allowed users to post threads about specific topics. The reason for adding this functionality was to create a space for students to discuss module- and website-specific topics. If used, this would contribute to the sense of community around the website and thus foster feelings of relatedness. This is also an example of the gamification principle of social interaction (section 2.4.4.2.5).

Threads were grouped under a specific topic, ranging from module admin to speaking about the quests. When users posted in the forum, their profile picture, achievement icons and title was displayed. This was so that the forum could be used as a form of display of achievement for the users.

The FAQ page contained a list of questions and answers about using the website that would make it easier to learn how to use the various features.

4.2.5 Section 5: Module

The module page was used for the admin of the module which made it a part of the non-gameful section of the website (see section 4.1 for an explanation). It showed the announcements made by the lecturer, allowed students to download their class notes, view their marks and ask questions about course content that they were struggling with. In a general sense, it made it possible to perform the general tasks associated with running a university module.

4.2.6 Section 6: Home

The home page (Figure 24) contained a number of different sections of information that allowed the students to be informed of what was happening in the module as well as on the website at a glance.

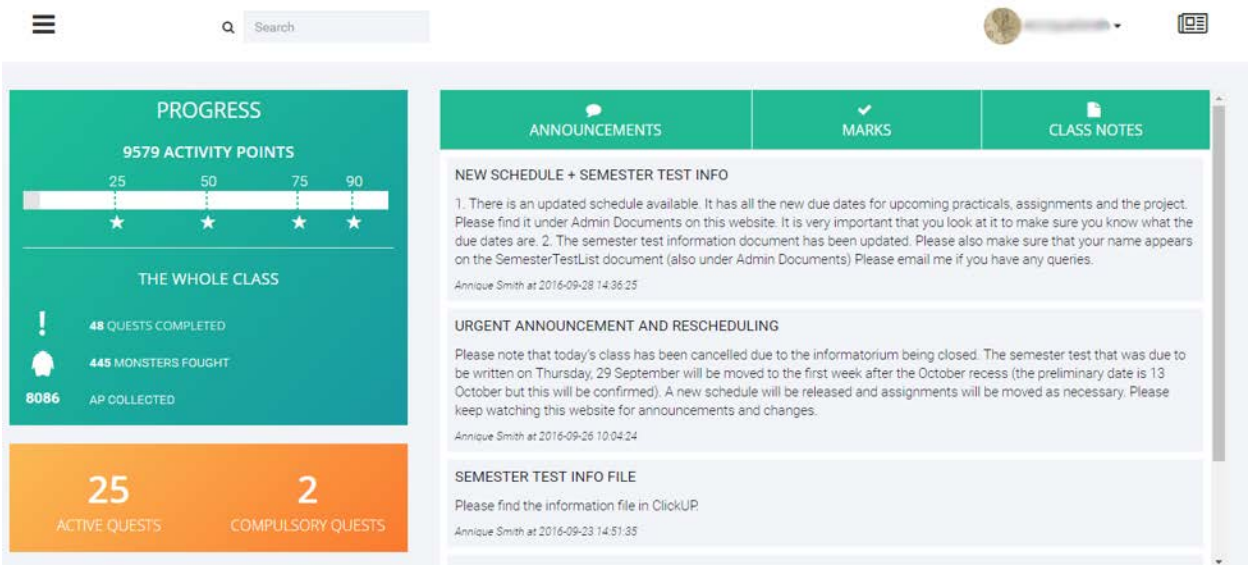

Figure 24 - The home page (pilot website)

On the right-hand side, the most recent announcements and class notes could be found, as well as the student's marks. This was all part of the non-gameful section of the website.

On the left was an overview of the progress of the individual user as well as that of the class (Figure 25). For the individual user it showed the progress bar used to unlock achievement icon slots on their profile (section 4.2.2) and their current number of AP. The user could also see how

Figure 25 - The progress section of the home page (pilot website)

many active and compulsory quests they had. The design of this feedback section was based on the design lenses of glanceable (Table 8, 5) and graspable progress (Table 8, 21). This is also an implementation of the feedback principle (section 2.4.4.2.2) because it helps the user to keep track of how well they are doing.

For the class as a whole, it showed the number of quests completed, monsters fought and AP collected. This was done to implement the traces of others design lens (Table 8, 23) and to remind students that their peers were also engaging with the website. This would contribute to the sense of community around the website.

4.2.7 Other features

An additional feature of the website which was not tied to any page was the notification area.

The notification area was used to notify users when their quests had been assessed, when they had gained a new achievement or when there was a new module announcement.

4.2.8 Summary of pilot system

The website was divided into two parts – the non-gameful, administrative sections and the gameful, optional sections. The primary focus of the website was on satisfying the three basic psychological needs of the users. This was aimed to be achieved by using only intrinsic motivation, which meant that none of the gameful parts of the website contributed to official course credit.

The focus on intrinsic motivation was driven by AP, which was intended to be the primary motivator on the website as it enabled or incentivised most of the available actions. The primary ways in which students could engage with the course content and satisfy their need for competence was by fighting a monster (completing a quiz on theory content) or doing a quest (completing a practical exercise). The map was the main way in which these activities could be accessed and it added value to the AP through movements on it costing AP. It was also intended to meet the need of autonomy by providing users with choices.

Finally, the addition of hidden achievements and titles enabled students to customise their profiles which further satisfied autonomy and enabled social interaction among the students through the forum, newsfeed and word of mouth. This was intended to satisfy the need of relatedness.

4.3 The pilot study – analysis and recommendations

The pilot study took place from June to November 2016. The website was implemented in the IMY 120 module in which the researcher was also the lecturer. At the end of the semester, students were asked to complete an optional questionnaire and attend optional focus groups.

The questionnaires were completed by 13 out of 43 registered students, and two of those students attended the focus groups. The results from the questionnaires, focus groups and website database are discussed below.

4.3.1 Results on the use of the website

When the website was first introduced to the students, a number of errors were uncovered and fixed. This was to be expected as it was the first time that the website was used by a large number of people. This testing is part of the fourth phase of the waterfall software development lifecycle model (section 3.2.3.4).

4.3.1.1 General frequency of use

The website was used quite a lot by students at the start of the implantation and this use steadily declined as the semester continued. This is shown in Figure 26 and Figure 27. Figure 26 shows that the parts of the website which the students used most often were the non-gameful parts (class notes, marks and announcements).

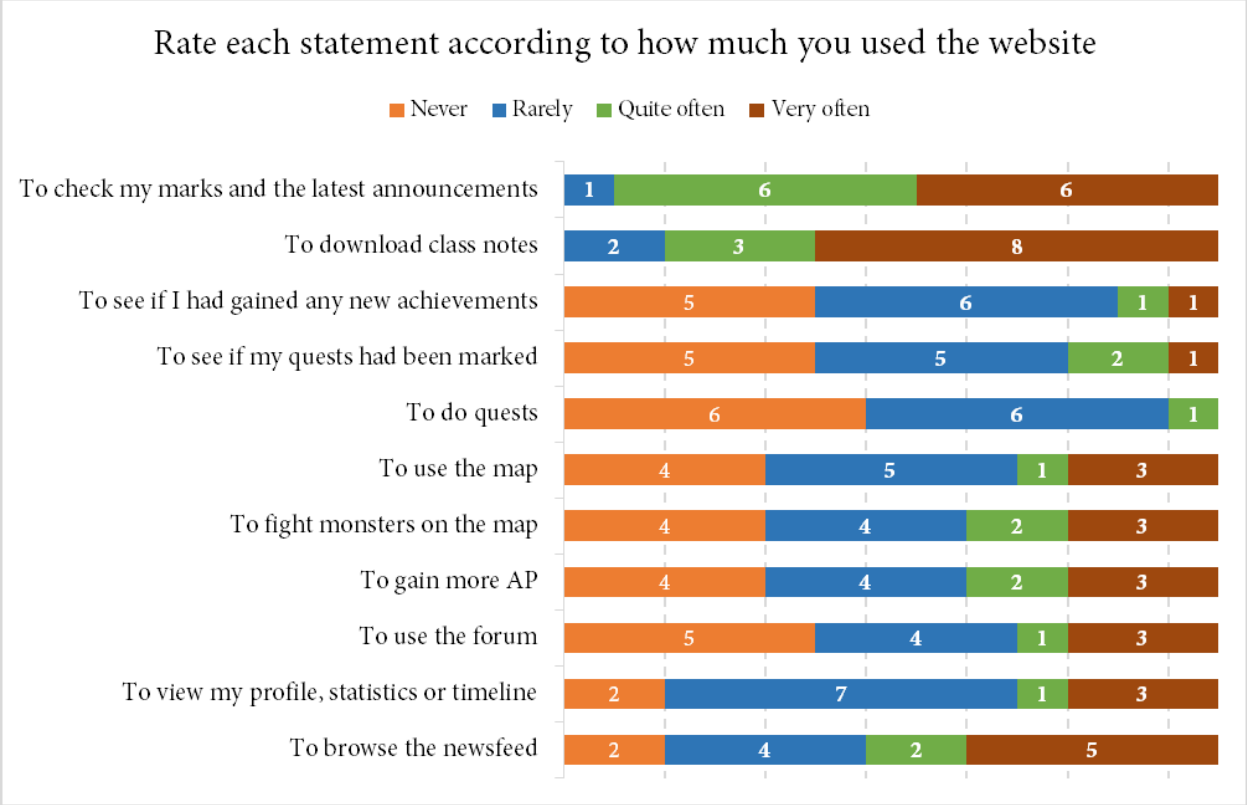

Figure 26 - Stacked bar graph showing the frequency of use of the different parts of the website by survey respondents (n = 13); source: pilot questionnaire

Based on what was seen (direct observation) about the use of the website, students were excited about it when it was first introduced. This can also been seen in Figure 27 and Figure 29 by the high numbers of quests and monsters encountered in August. However, the errors which arose early on hindered the students from using the website properly and they seemed to lose interest. Additional reasons for losing interest are explored in the following sections.

4.3.1.2 Quests

Figure 27 shows both the decline in interest in the website as well as the low numbers of quests submitted throughout the semester, with the most submitted on one day being eight quests. 59 quests in total were submitted, with 34 of them being completed by a single user. Overall, only 16 different users submitted quests.

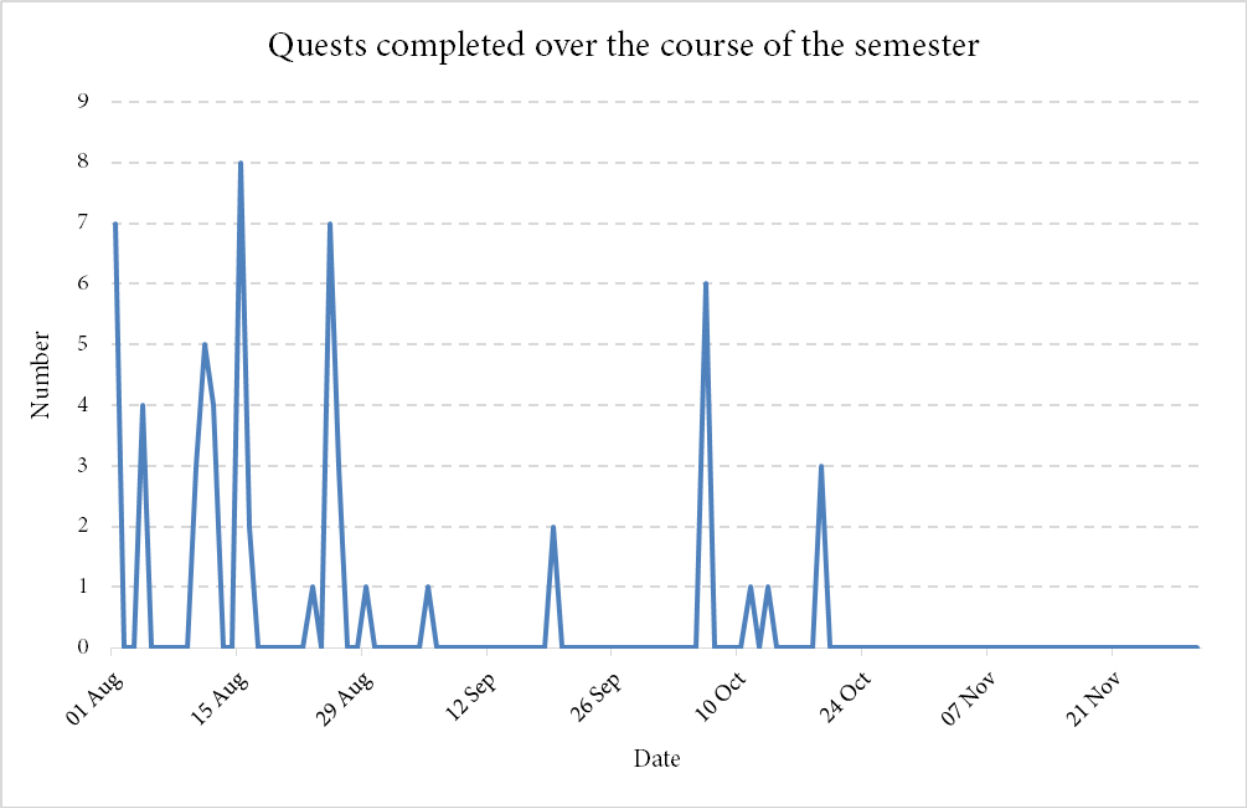

Figure 27 - Line graph showing the total number of quests submitted each day during the semester (n = 43); source: pilot website database

Reasons for not doing quests (cited in the questionnaire) included both time issues and errors on the website. Time issues in this context refer to students feeling like they did not have enough time in general to justify spending it on the quests. For example, one questionnaire respondent

said the following: “Time is precious and although it would not have been a waste, other modules needed more time”.

Of particular importance were the responses which mentioned preferring to use the Adobe programs in their own way instead of being told how to do so. For example: “If I'm gonna [sic] do work in adobe [program], I'm gonna [sic] do it on my own terms”. This issue was also raised in the focus group. The participant explained that he did not like being told how to exercise his creativity in order to learn to use the program. As an example, he said that one of the quests provided an image of a child behind a tree and this image bored him. He preferred to choose his own images and practice using Photoshop on his own.

In addition, one respondent mentioned that doing the quests from home required access to the Adobe software, which was expensive. Whilst being on campus, students had free access to the software. This meant that for some students, it was difficult to do the quests at home, which would generally be when they had free time. It was also noted by the researcher that downloading a quest and having to open the Adobe software had the potential to break the flow (section 2.1.2) of the user because they had to switch between applications and perform a completely different task.

4.3.1.3 Monsters

The monsters were more popular than the quests (Figure 26, Figure 28) and engaged more users overall.

Figure 29 shows this, with 129 monsters fought on the day the website went live. A total of 35 different users fought monsters. However, there is still a clear downward trend in the level of engagement, with a spike the end of the semester as students prepared for their exam (which took place on 30 November). This spike shows that the students understood the value of the monster element in helping them to prepare for assessment. In the questionnaire, some respondents quoted this as a reason for engaging with the monster element - “the quizzes are very quick to do and quite an enjoyable way to learn some theory”.

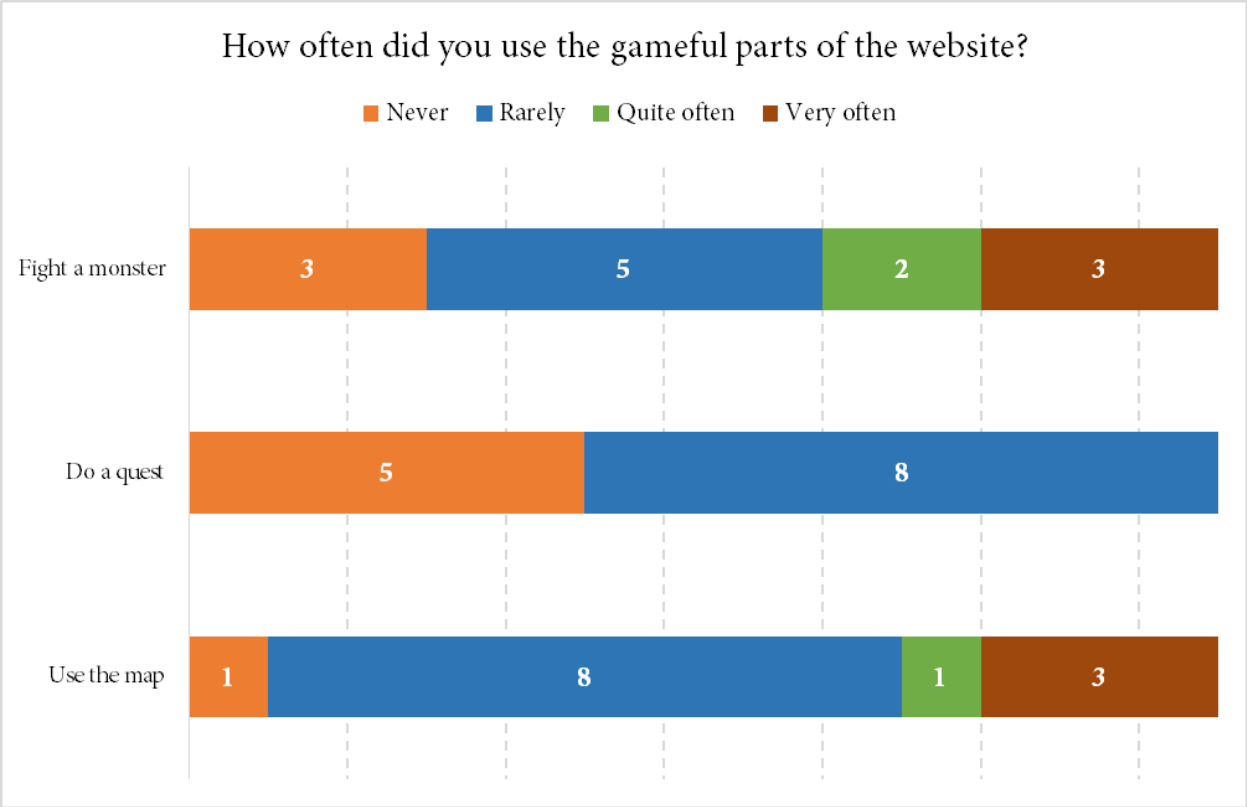

Figure 28 - Stacked bar graph showing the frequency of use of the main gameful parts of the website (n = 13); source: pilot questionnaire

Some questionnaire respondents said that they used this feature to gain AP - "I enjoyed gaining AP and used it to study for the semester test". This provides evidence for the positive power of AP within the system, which is surprising because the shop component was barely used. A possible reason for this may be the map element, which was used quite extensively (Figure 26).

Other respondents mentioned being put off by the number of errors or lack of time. In the focus groups it was mentioned that fighting the monsters very quickly became boring as they were all very similar. It was also evident from the website database data that the battle cards (section 4.2.1.1.3.2) were not used/purchased and in fact, one focus group respondent reported using these cards as a way to exploit the monster system in order to avoid fighting the monster but still getting the AP.

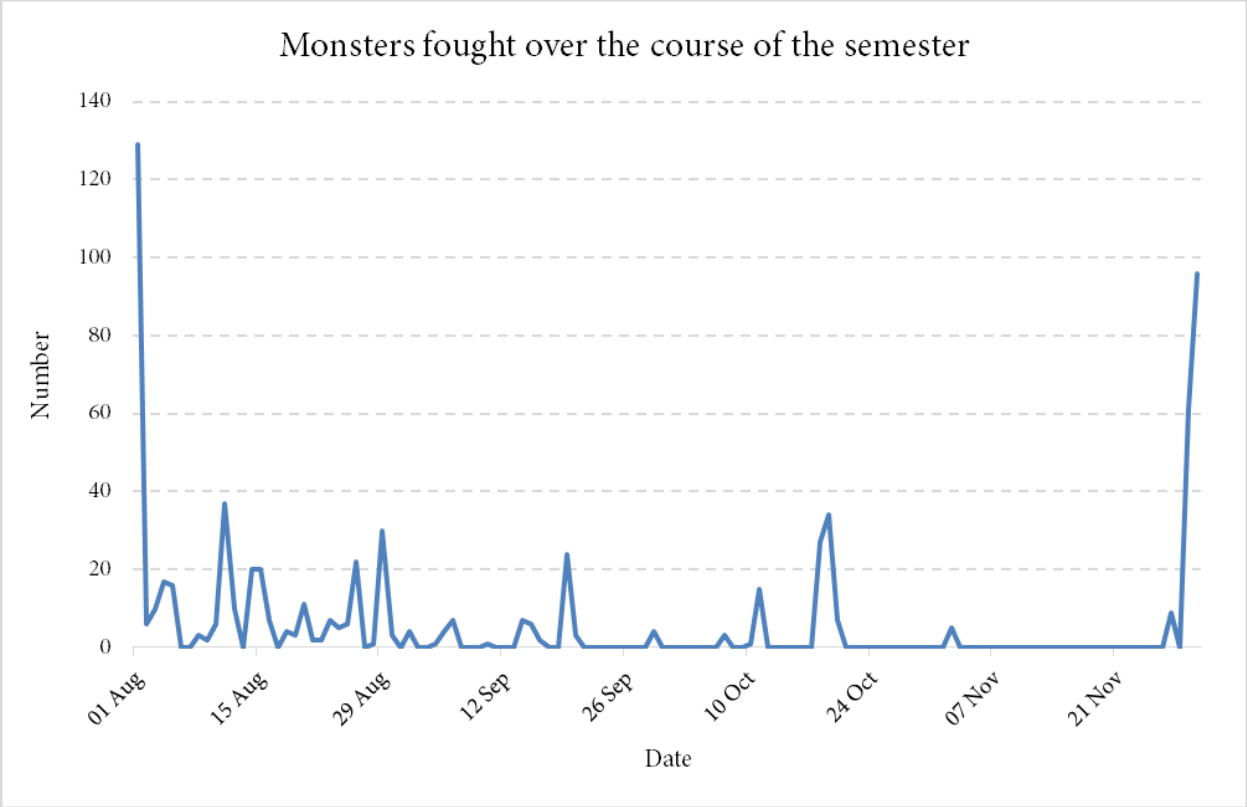

Figure 29 - Line graph showing the total number of monsters fought each day of the semester (n = 43); source: pilot website database

4.3.1.4 Map

The map was less popular than the monsters (Figure 28). When considering the responses provided in the questionnaire, it is clear that the students viewed the map and the monsters as the same element. The following response shows this clearly (when a respondent was asked why they used the map): "I really liked getting AP and answering questions, as it felt very rewarding". This is not a surprising response as the map was only intended to facilitate finding the monsters and quests in an interesting way. However, in general, respondents explained that a lack of free time was a hindrance to using the map well as a lack of motivation to engage with it. Regarding the lack of motivation, one respondent said that they "didn't feel the need to use it". A possible reason for this type of response might be that the number of maps was overwhelming and there was no real difference between them except new quests, which were not motivating enough to engage with (see section 4.3.1.2). In addition, the AP component did not have the intended effect of driving user behaviour on the system (because there was not much interaction that took place), and the map element hinged on this.

In addition, the focus group participants explained that they felt that they were too many maps to explore. The data from the website (database) show that students barely explored the wormhole maps.

4.3.1.5 Profiles and achievements

With regards to earning achievements, some respondents enjoyed earning them and felt proud when they did so, while others said they did not earn any and could therefore not provide much clarity in that regard. Responses included, “I enjoyed receiving cleverly named achievements”, “It felt nice, I enjoyed the new way of seeing progress made” and “It was nice to get them. Didn't really interest me though”. The references to “nice” and “enjoyed” might hint at the fact that receiving achievements facilitated feelings of competence. One respondent reported feeling “proud” after earning an achievement, while another said that they “felt [like] a king” and yet another said that they “enjoyed the new way of seeing progress made”. These statements provide evidence for the ability of the achievements to bolster feelings of competence in users. The general response towards achievements was positive.

The profile customisation did not have the intended effect of allowing students to show off to each other because the majority of them did not have an interest in viewing the profiles of their classmates.

In general, the users did not really engage with the profile section of the website. This was seen through evidence on the website when users did not update their achievement icons when they had unlocked slots to do so, as well as when they reported (in the questionnaire) not often changing their titles.

4.3.2 Recommendations for improvement

A large part of the focus group was centred on ways in which the website could be improved for its next implementation.

The participants highlighted the fact that there were too many maps to explore. Instead, they said it would be better if there are one or two bigger maps for the whole semester. “There was a map for every week, more or less, but it kind of felt like it became too much because each map had like five or six monsters or quests...So maybe like have either one or two big maps...”. This was also mentioned in the questionnaire by one respondent.

The idea of incorporating an overarching story into the website was also mentioned – "I felt that maybe try and integrate a theme into it, into the entire module itself". The focus group participants felt that motivation could be fostered if there was a larger goal to work towards. This is the gamification concept of narrative discussed in section 2.4.4.2.3. It is helpful in a learning context because of the principle of situated cognition (section 0). When learning takes place within a deeper context, it is easier to understand the concepts being taught.

The idea of making the blue moving token customisable was also raised. This would mean including items in the shop that would allow users to change the appearance of the token. "Maybe a cosmetic item for your character, if we are going to the point where you customise your character, and they see they can add a cosmetic item that's maybe expensive or just looks really nice". This would expand on the concept of customisation which was originally included in the ability to change achievement icons and titles (section 4.2.2.2). Customisation satisfies feelings of autonomy by providing users with choices to express themselves and their identity (section 2.1.3.2).

The concept of challenging other users at module content was also discussed. This would mean giving users the ability to place bets on quests and practicals and challenge their friends to see who could perform the task better. This would help to satisfy the need of relatedness and providing an opportunity for social interaction (section 2.4.4.2.5).

Finally, one or two comments on the survey referred to a need for a mobile version of the website which made it easy to view announcements and check marks. General errors and exploits were also raised and taken note of.

4.3.3 Summary of pilot study

In summary, the results of the pilot study revealed a number of issues in the design of the website. One of the largest problems was the fact that the students did not engage in the quest section due to the fact that they preferred to explore the Adobe programs on their own. This is an indication that the design of the quests was not appropriate for the content being taught. The two available solutions to this problem were: heavily changing the design of the quests to accommodate the content of the module or changing the content being taught in order to match the current quest design.

Choosing the former option would have had certain complications because of the nature of the course content. In a general sense, practising a skill in a content-creation application such as

Photoshop is not often a quick task as one would tend to experiment with the tool being learnt. As described in section 4.2.1.1.4, the quests were designed to be quick tasks. This meant that if the same content was to be taught using the final system, the quests would have to be re-structured into longer, more intricate elements and the general design of the other gameful elements might have to be reconceptualised to allow for this change. Additionally, as described in section 4.3.1.2, having to download the quest and switch to a new application had the potential to break the flow of the user. This was unavoidable given the nature of the course content.

Based on these two reasons, it is possible to see how this particular gameful website is not completely well-suited to facilitating the education of content-creation applications. This is what led to the decision to implement the final website in a different first-year undergraduate module. The module chosen is described in section 4.4.1.

Additionally, the map and the monsters required some redesign, and some interesting ideas were raised in the focus group that were incorporated in the final website. These changes are discussed in section 4.4.

The pilot study was incredibly valuable because the extensive use of the system uncovered a number of errors which were subsequently resolved. Additionally, it was necessary to see how the students approached the website in order to make sure that the final system was able to meet all their needs. The data gathered was instrumental in helping to improve the website for its final implementation.

4.4 The final website

Based on the results from the pilot study, a number of changes and improvements were made to the website. These changes and their motivations are discussed in detail in the following sections.

4.4.1 Course content change

As discussed in section 4.3.3, the results from the pilot study made it clear that the course content taught by the system was not appropriate for the gameful design implemented. For this reason, the website was modified so that it could be used in the module of IMY 110 instead.

IMY 110, a first-year module in the first semester of the (BIS) Multimedia program, is a module that introduces students to website development by teaching them how to use HTML and CSS to create basic static websites. This module content is considered more rigid and less subjective than that of IMY 120 (the module in which the pilot system was implemented). This means that the

complaints of the students (section 4.3.1.2) about being told how to exercise their creativity would not be applicable since learning the concepts of HTML and CSS does not involve creativity. It is to be noted that the creative/logical thought processes required to learn complex programming languages do not apply in this case because learning HTML and CSS is simply a process of understanding how an element works and knowing when and how to use it. There is no problem-solving required.

4.4.2 Map changes

The map underwent some significant changes in response to the data gathered in the pilot study.

Firstly, respondents reported feeling overwhelmed by the large number of maps. Results from the website data also showed that the wormhole maps were not used (section 4.3.1.4). As a result, the primary change on the map consisted of removing wormholes and wormhole maps entirely and using two large maps for all the content instead of one per week. The IMY 110 module contains two main sections of content: the first teaches HTML markup and the second teaches CSS styling. There was one map dedicated to each of these sections. Each map contained quests and monsters relating to the section in question. The HTML map was available to use at the start of the semester because HTML was taught first. The CSS map became available once the content began to be taught in the module. Reducing the number of maps would prevent students from being overwhelmed by how much they had to explore.

Additionally, a map selection screen (Figure 31) was added to make the selection of maps a more interesting experience by allowing the user to navigate their avatar using the arrow keys in order to choose which map to travel to.

In the pilot system, the quests on the maps were placed according to the week of the semester (hence one map per week). Since these weekly maps were removed in the new system, in order to ensure that the students encountered the quests in the correct order, the quests were placed in their relevant map (HTML or CSS) in a random position, but within a fixed area. In order to do this, the map was divided into three sections as shown in Figure 30.

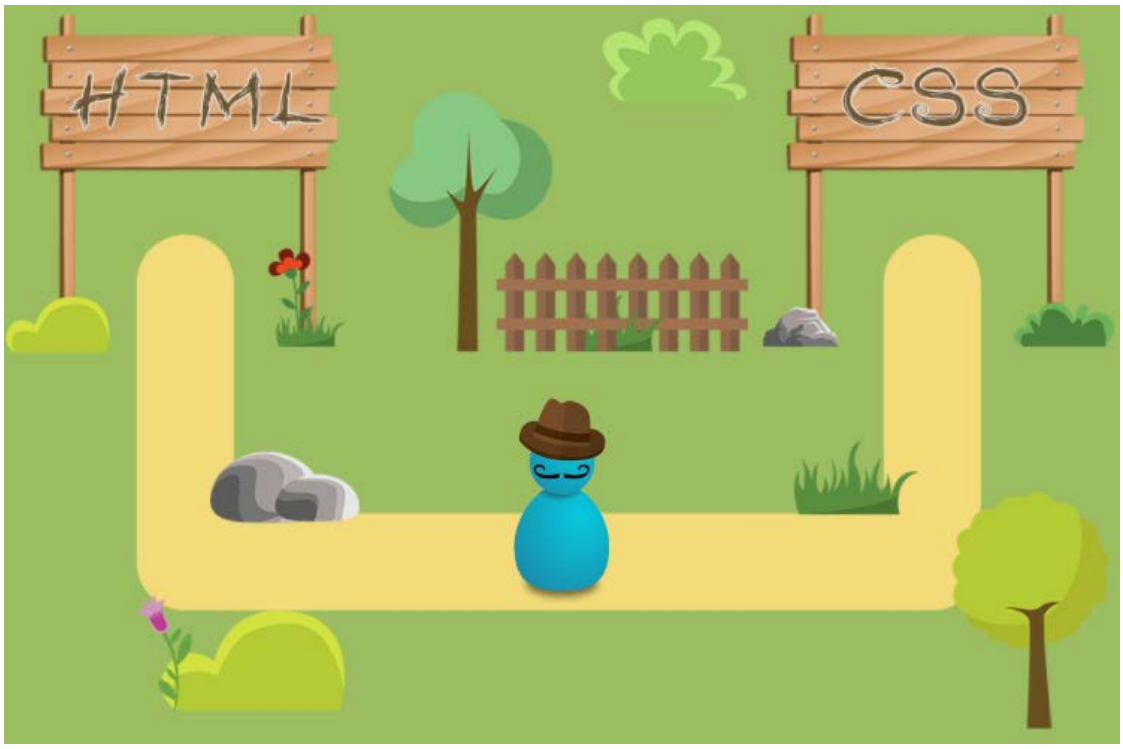

Figure 31 - The map selection screen (final website)

1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	2
1	1	1	1	1	1	1	2	2
1	1	1	1	1	1	2	2	2
1	1	1	1	1	2	2	2	2
1	1	1	1	2	2	2	2	3
1	1	1	2	2	2	2	3	3
1	1	2	2	2	2	3	3	3
1	2	2	2	2	3	3	3	3
2	2	2	2	3	3	3	3	3
2	2	2	3	3	3	3	3	3
2	2	3	3	3	3	3	3	3
2	3	3	3	3	3	3	3	3

Figure 30 – An illustration to show how the map was divided into three regions in order to place the quests so that the users encountered them in the correct order (final website)

The starting position of each user was the same; at the top left-hand corner of the map. The quests relating to content taught earliest in the section were placed in region 1. Quests relating to content taught after these were placed in section 2, and so forth. Since each map was randomly generated, it was impossible to determine where the user would move, but it could be assumed that they would most likely encounter the blocks in section 1 first, then section 2 and finally section 3. This meant that they were more likely to encounter quests that were equal to their skill level. This was done as a type of scaffolding (section 0) as well as to ensure that competence would be satisfied as the user encountered optimal challenges (section 2.1.3.1).

The size of each map was set based on the number of quests. This was done to allow roughly ten blocks for each quest. This ensured that users would have to spend at least some AP to find a new quest, but at the same time they would not have to spend too much.

Figure 32 shows the top section of the final map. The layout of the map page was altered slightly to make it easier to find buttons (in order to fight a monster or view a quest) and to improve the general usability of the page (Figure 33).

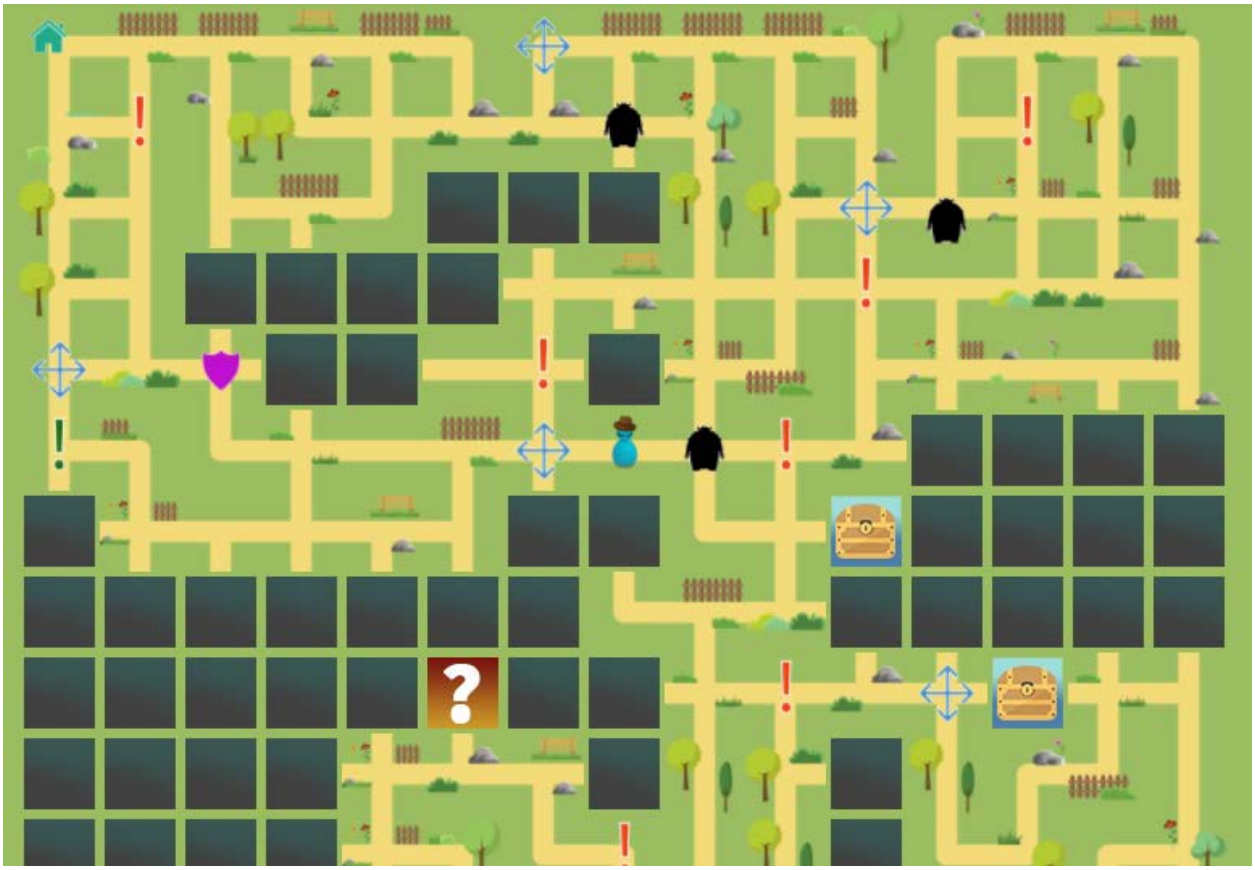

Figure 32 - The map layout (top section) (final website)

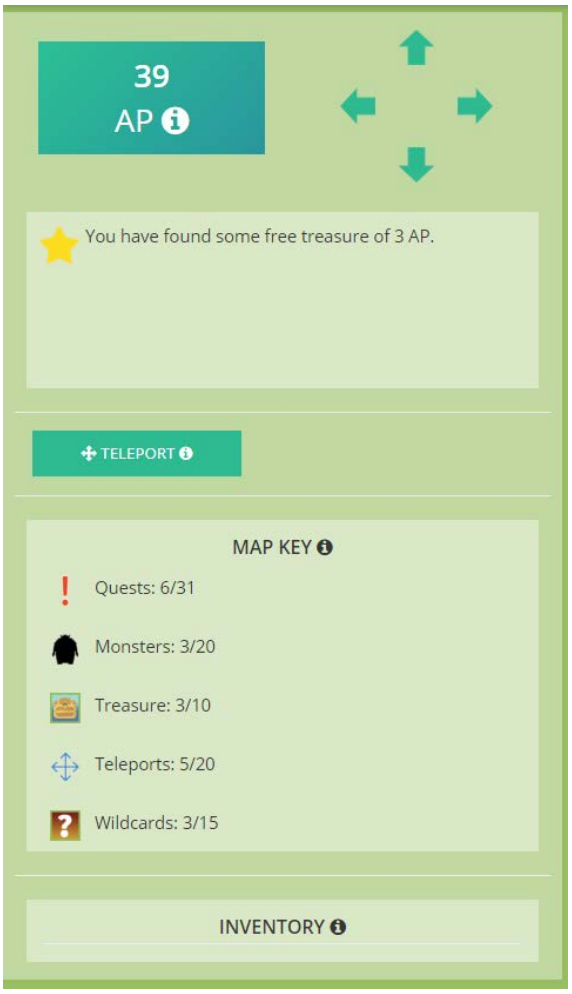

Figure 33 - The map dashboard (final website)

4.4.3 Monster changes

Feedback from the pilot study showed that the users found that the monster element quickly became boring. In order to prevent this, a number of changes were made. Firstly, additional monster images were added and each monster was given a short, witty description (Figure 34). As explained in section 4.1, this humour was intended to add to the playfulness of the website as a whole, and in this case, to make the monsters more interesting. The monsters were randomly positioned across both maps so that the user would only encounter each monster once.

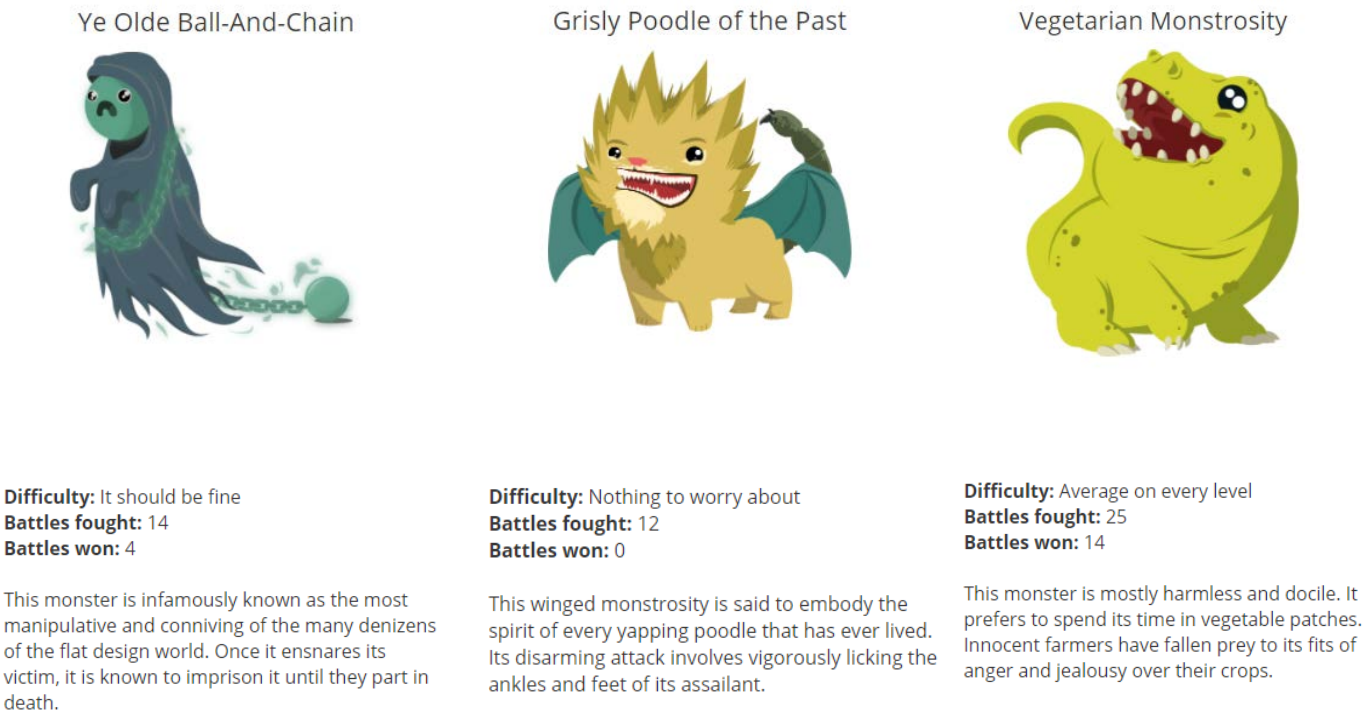

Figure 34 - Three monsters and their descriptions (final website)

Secondly, monster abilities were removed as this cluttered the interface and made the monster element confusing. Instead, the monster's difficulty level was represented as a sentence (Table 14) and the monster levels were modified to accommodate the progress bars added to the battle section.

Monster level	Percentage of progress bar filled	Sentence description
1	16.7	Nothing to worry about
2	25	It should be fine
3	33.3	Average on every level
4	50	Could prove challenging
5	100	Back away slowly…

Table 14 - Monster level and corresponding difficulty of quiz (final website)

Progress bars (Figure 35) were added to the quiz section which made it easier and more entertaining to visualise the progress of the battle.

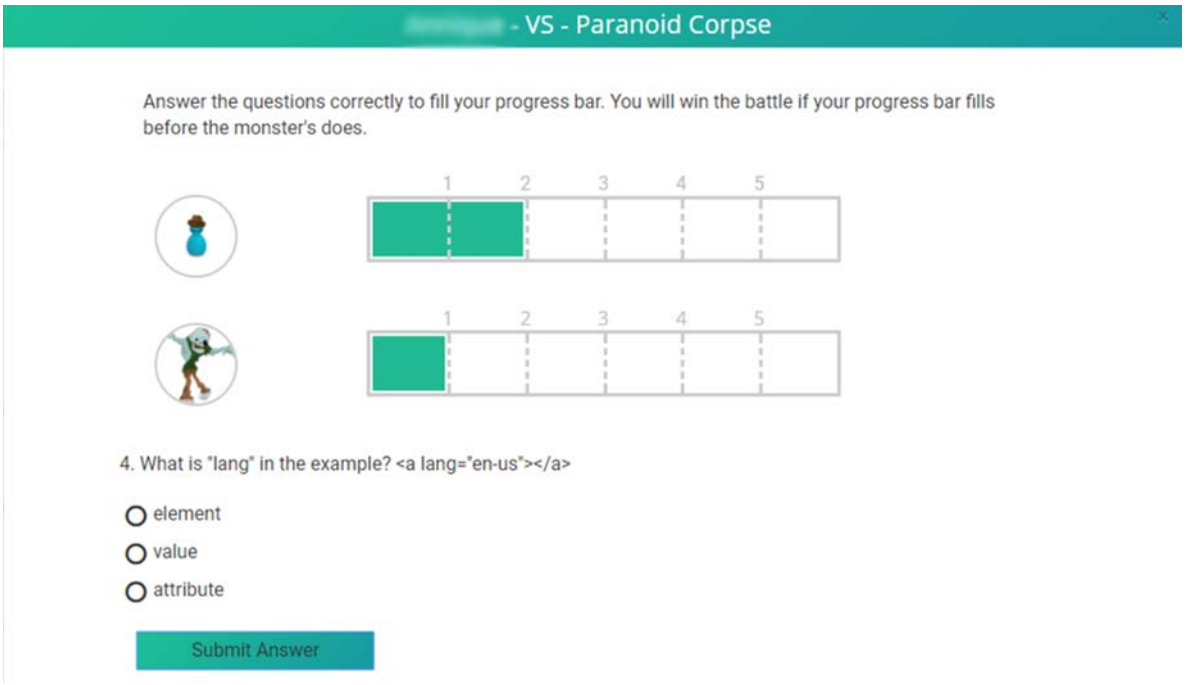

Figure 35 - The battle screen shown when fighting a monster (final website)

When the user answered a question, the appropriate progress bar would be filled. This process was animated as an implementation of juicy feedback (Table 8, 2). For example, if the user answered the question correctly, their progress bar would increase by one notch. If the user answered the question incorrectly, the monster's progress bar would increase by the percentage equal to their level (Table 14). If the user filled their progress bar first, then they would win the battle, otherwise the monster would win. Allowing the user to view their progress in the quiz in such a visual way was intended to satisfy the need for competence by providing immediate feedback (Table 8, 1) which appeals to motivations (Table 8, 4). It was also an implementation of glanceable feedback (Table 8, 5).

The power-up cards (section 4.2.1.1.3.2) were also removed since it was indicated in the focus group that they were used to exploit the system and were also not very popular among the users (section 4.3.1.3). Finally, the layout of this element was improved. The first screen (the battle preparation screen) was altered from what can be seen in Figure 13 to what is shown in Figure 36

in order to decrease clutter and make it more visually appealing. In addition, the inclusion of the progress bars caused the layout for the quiz section to change from Figure 14 to Figure 35.

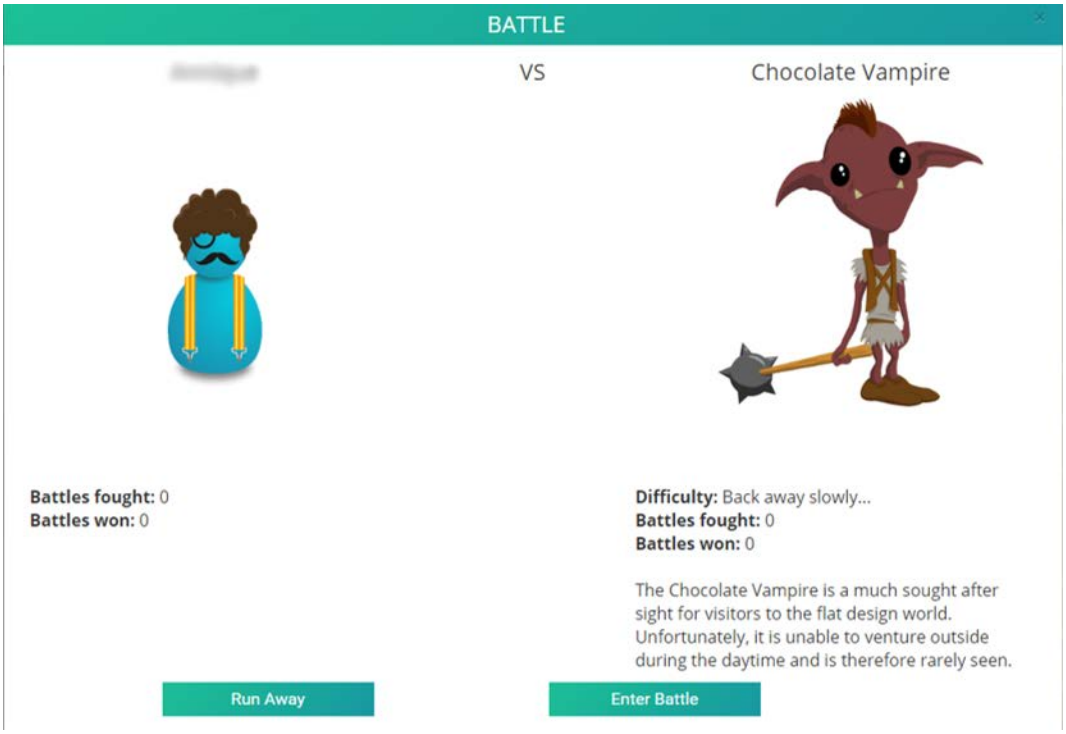

Figure 36 - The battle preparation screen (final website)

4.4.4 Quest changes

Quests changed significantly, partly because the module of implementation changed. Due to the fact that IMY 110 focuses on teaching markup languages, it was possible to integrate a code editor and result viewer on the website which meant that users did not have to download any files or use any other programs in order to complete the quests (Figure 37, Figure 38, Figure 39 and Figure 40).

This made the process of doing a quest faster, but also prevented a break in flow for the user when using the website (as described in section 4.3.1.2). Since the quests were designed to be done quickly (section 4.2.1.1.4), the integrated code editor made it possible to test the students on small elements of the content.

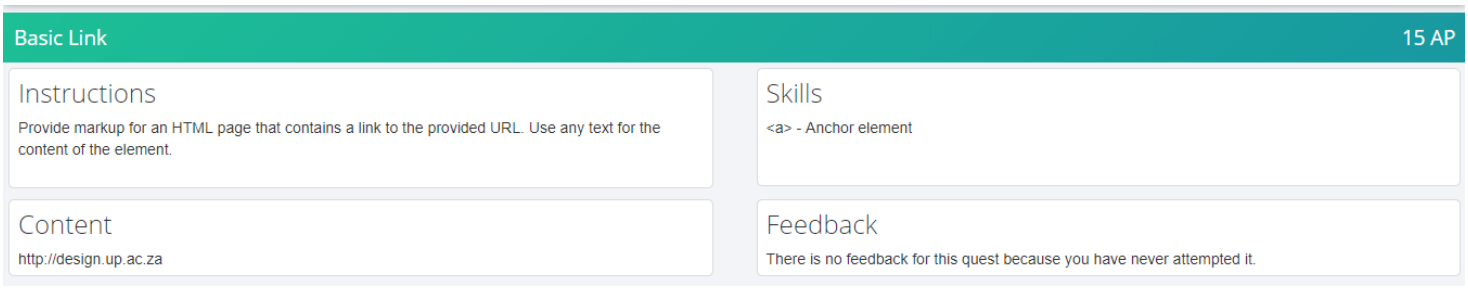

Figure 37 -An HTML quest (top-half of the page) showing the instructions of the quest, the skill that will be earned and the feedback from previous attempts (final website)

Figure 38 -An HTML quest (bottom-half of the page) showing the area into which code can be typed (left) and the result of the code (right) (final website)

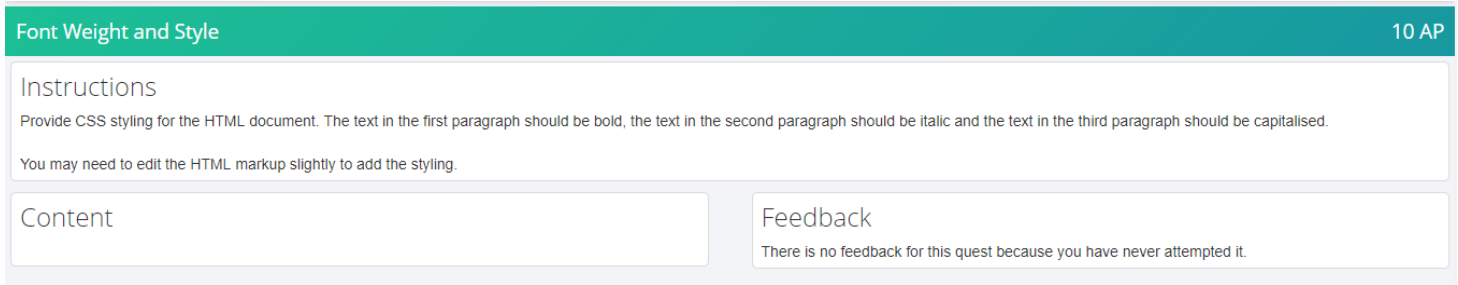

Figure 39 -An HTML quest (top-half of the page) showing the instructions of the quest, the skill that will be earned and the feedback from previous attempts (final website)

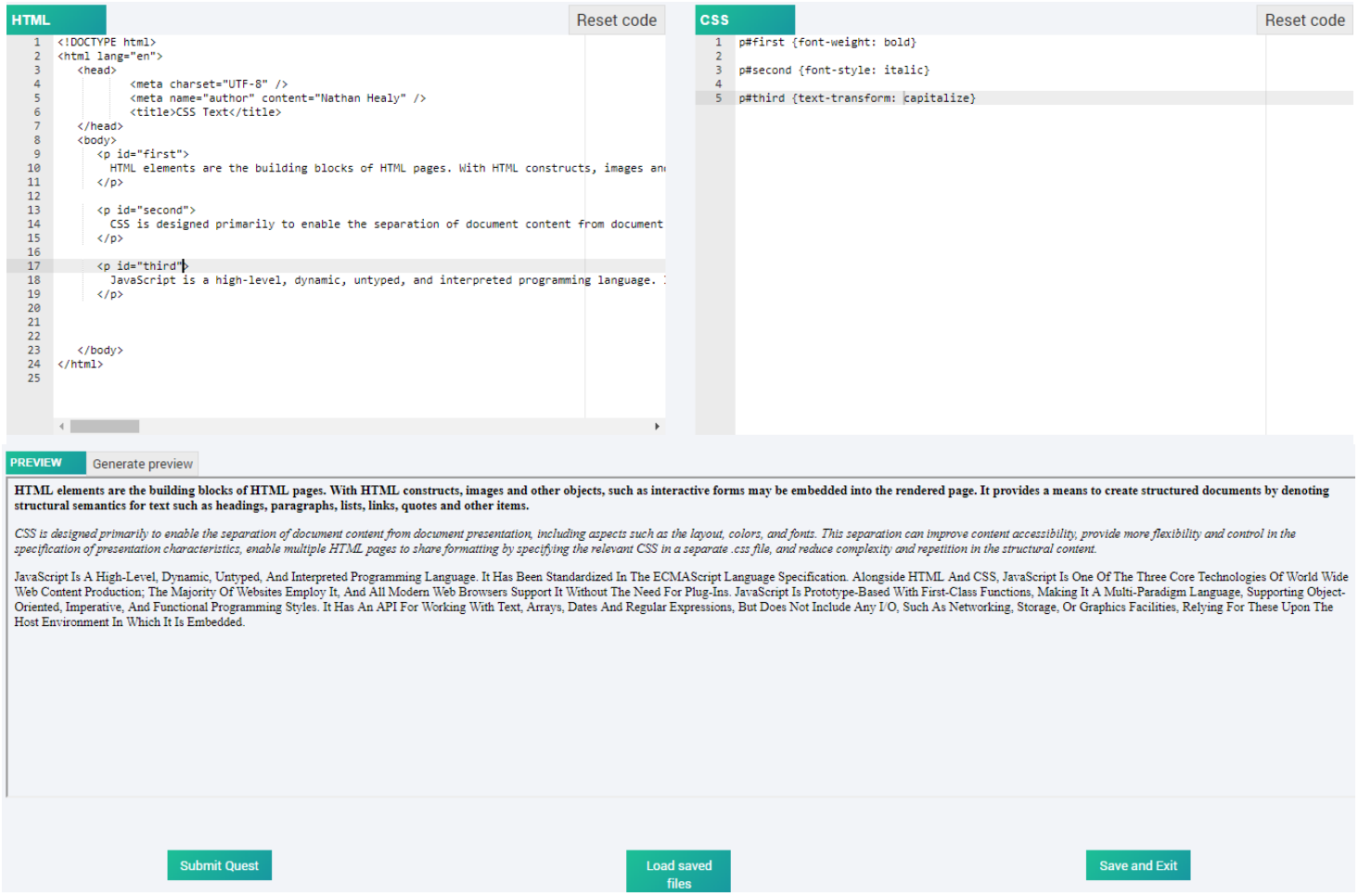

Figure 40 - A CSS quest (bottom-half of the page) showing the window to type in HTML code (left) and the window to type in CSS code (right). The result of the code is shown below these two windows (final website)

Another addition to the quests was the concept of skills (described in more detail in section 4.4.8). Each quest was associated with one or more skills and this was displayed to the user. When the quest was completed successfully, this skill was added to the user's profile page (Figure 41).

HTML SKILLS	
	Unordered list element
<p>	Paragraph element
	Ordered list element
	List item element
<h1..6>	Heading elements
<video>	Video element
CSS SKILLS	
background-color	Background colour
font-weight	Text boldness
font-style	Text styles
text-transform	Text transformations
font-family	Font type

Figure 41 - The list of skills earned by a user, shown on their profile (final website)

4.4.5 Achievement changes

The list of achievements was adapted to account for the changes to the website. This means that the achievements awarded for exploring wormhole maps, buying cards from the shop and defeating monsters more than once were removed. Additionally, the constraint that required users to fill a progress bar to unlock achievement icons on their profiles was removed. This was because many users did not explore enough to unlock any icons which meant that they did not have a chance to use this feature. Since the wormhole maps were removed, this would also no longer be relevant. Users would be able to display up to four different achievements at any time.

4.4.6 Customisation and shop changes

A new gameful section was added that allowed the users to customise their blue avatars with items purchased at the shop (Figure 42). From their profile pages, users could access a page that allowed them to change the items in which their avatar was dressed (Figure 43).

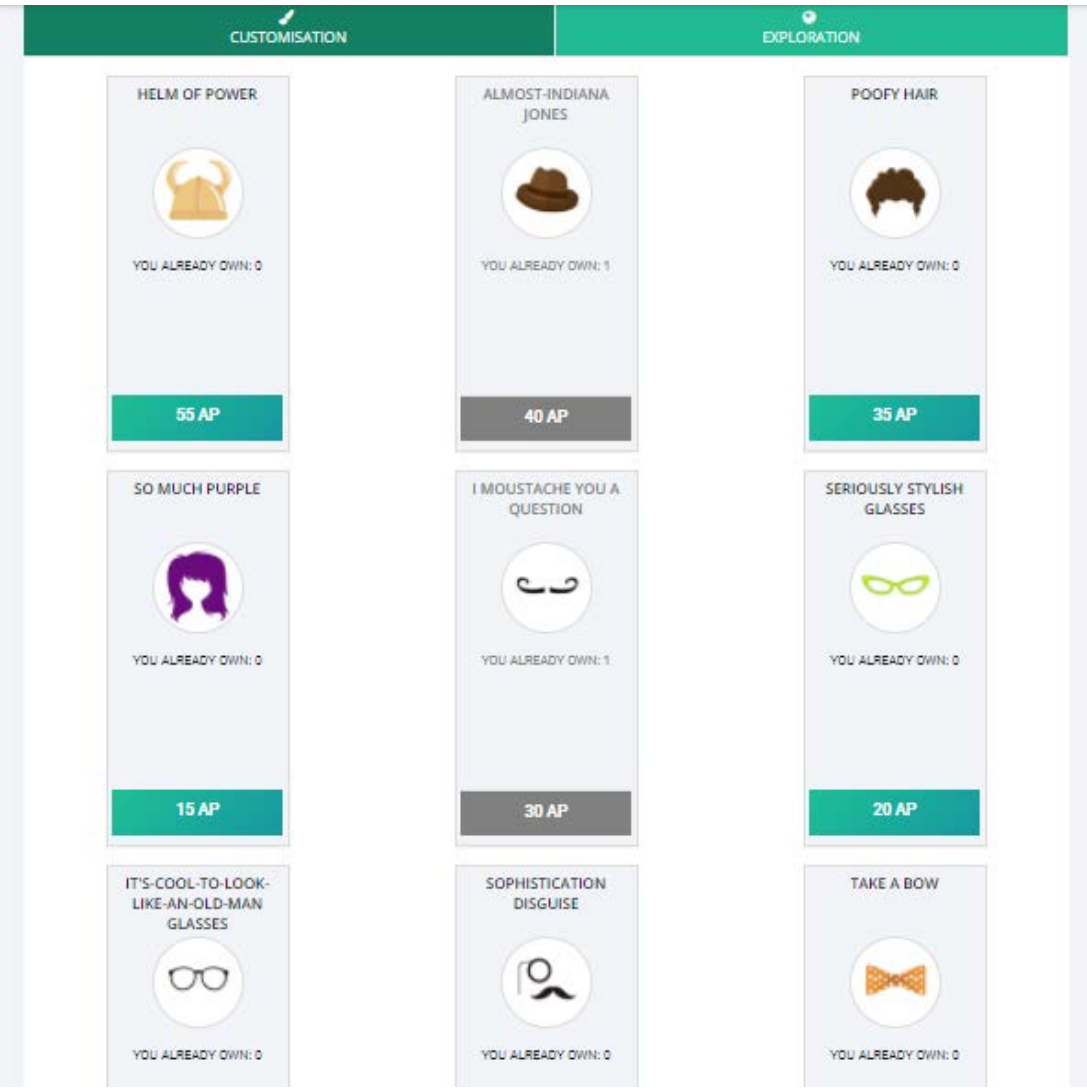

Figure 42 - The shop with customisation items (final website)

Item categories included head-wear, face accessories and neck accessories. Additionally, users could also purchase frames for their profile pictures. As a result, a large number of different configurations of profile images could be obtained (Figure 44).

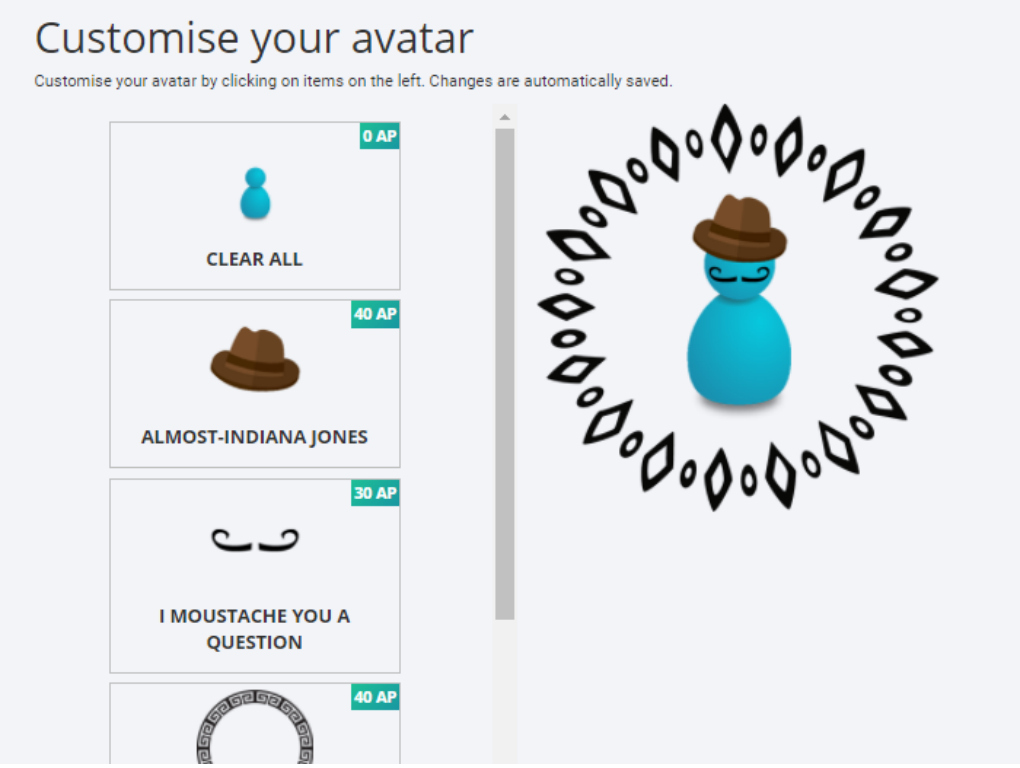

Figure 43 - The customisation section (final website)

Figure 44 - Examples of different profile images

This is an extension of the customisation options provided in the pilot system (achievement icons and titles). Customisation fosters autonomy by providing users with choices as well as allowing them to define their own identity and increases their sense of agency (section 2.1.3.2). Since the battle cards were not successful in the pilot system (section 4.3.1.3), they were removed. Adding the customisation items to the shop instead ensured that AP still has a high value within the system. It also allowed users to create their own goals within the system (again fostering autonomy) by saving their AP to buy a specific item.

4.4.7 Challenge system

Based on the feedback in the focus group, a challenge system was added which allowed users to place bets with their classmates on their performance in a practical, assignment or quest.

The system (Figure 45) allowed a student to nominate another student to challenge, place a wager (using AP which was deducted from their current AP total) and choose a task.

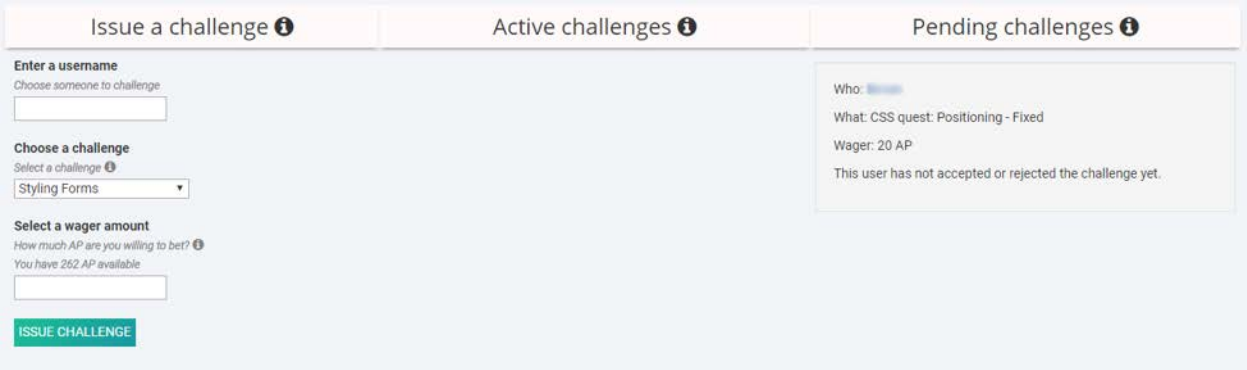

Figure 45 - The challenge page where users could issue challenges (final website)

If a practical or assignment was chosen as the task, the winner would be the student who received the highest mark. If a quest was chosen, the winner would be the student who completed the quest successfully in the shortest amount of time. Upon nominating a user, the nominated user would have to accept the challenge in order for it to become active. Once this had happened, the challenge was placed on a newsfeed page (Figure 46) to allow other users to view it and the final outcome.

This functionality was recommended during the pilot study focus groups (section 4.4.7). It was added to the website to give users a means by which they could show off their skills to their classmates and in doing so, foster feelings of relatedness through social interaction (section 2.4.4.2.5). This would also foster feelings of competence by giving users a chance to test their skills.

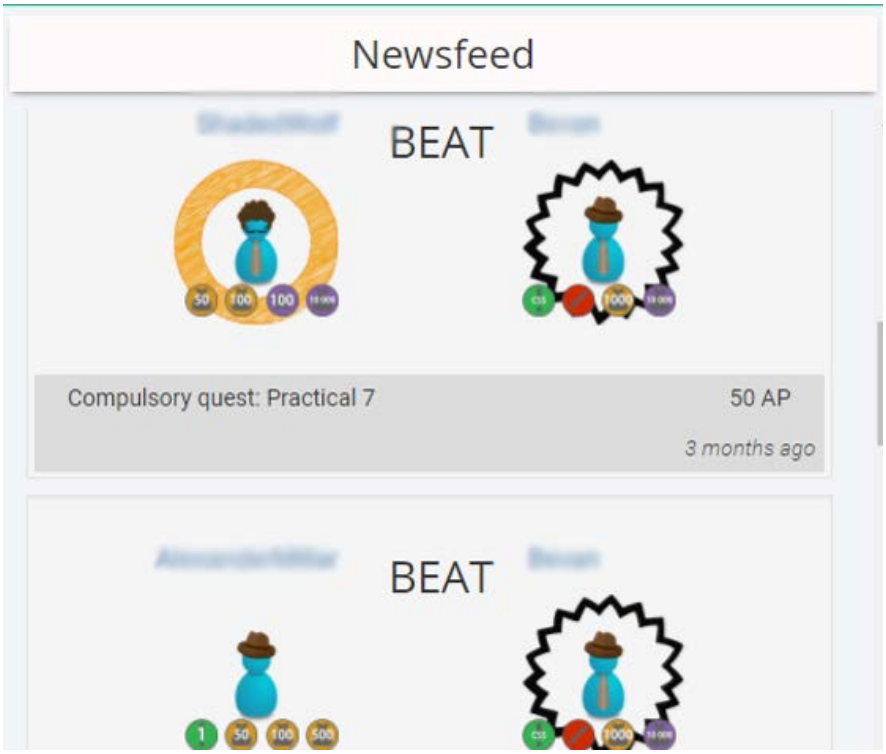

Figure 46 - The challenge page newsfeed showing the most recent challenges and their results (final website)

To prevent students from feeling pressured to engage with the challenge element, a user first had to accept a challenge before it became active and added to the newsfeed. They also had the opportunity to reject a challenge and this would not be added to the newsfeed.

Figure 47 shows the skill atom of a challenge. It is important to note here that this skill atom technically contains the quest skill atom, as doing a challenge also requires doing a quest (if that is the task chosen by the user).

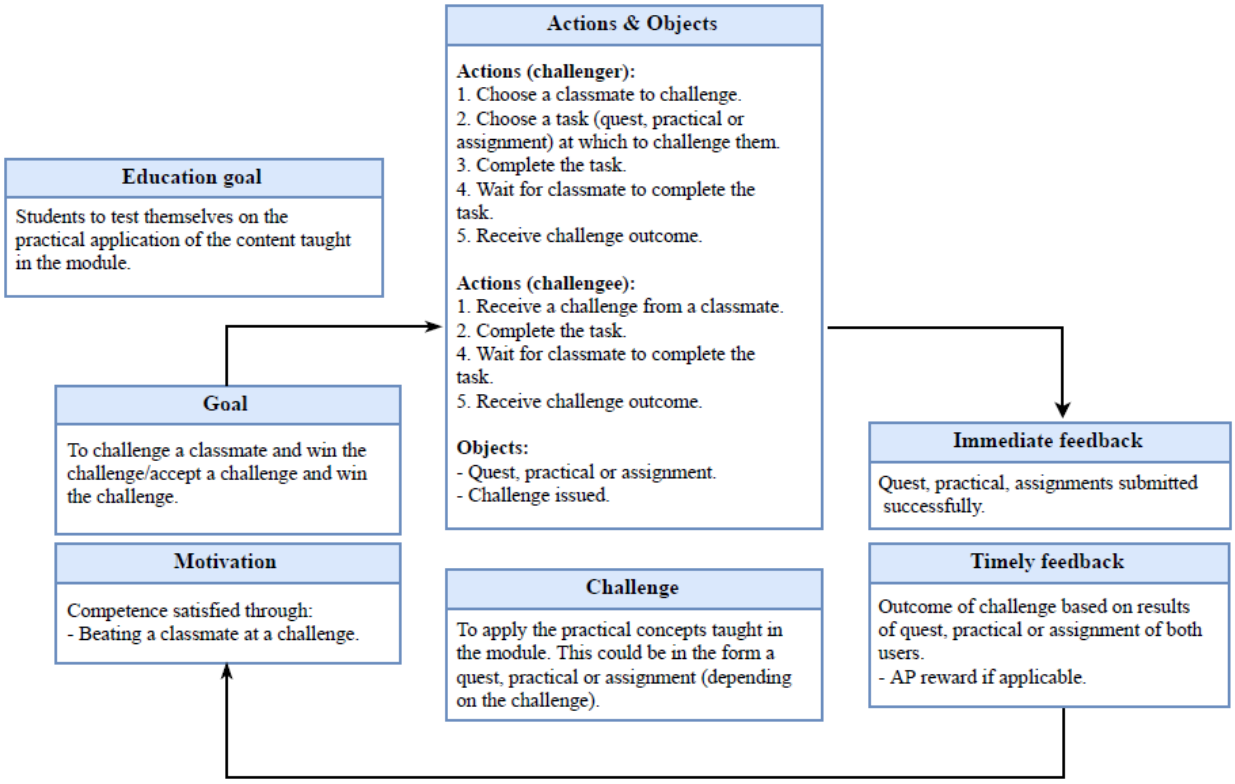

Figure 47 - The challenge skill atom

4.4.8 Overarching narrative

A narrative was added to the website to tie the gameful concepts together. A narrative is helpful in a gameful education setting because it can create a context which makes concepts easier to understand (section 2.4.4.2.3). This is because of the principle of situated learning (section 0).

The narrative added to the gameful website was centred on designing a website. This provided the perfect context for a module which taught the basics of website design. The story is about a fictional character called Nathan Healy who is a young student. It is summarised as follows:

Nathan accepted a web design job because he desperately needed the money; however, he soon realised that he did not have the skills to complete the website. While working late one night to try to learn web development, something terrible happened and he woke up in the world of flat design. The flat design world is a dangerous place that is full of monsters. Nathan appeals to the students to help him design and create the website while he tries to figure out how to get out of the flat design world and back to the real world.

This story was introduced to the users through a video shown in class in which Nathan (represented by an actor) explains the story to the students. He comes across as frightened and nervous, stating that he needs the students to help him. Figure 48 shows a still frame from the video shown to the students alongside the cartoon representation of Nathan which was used on the website.

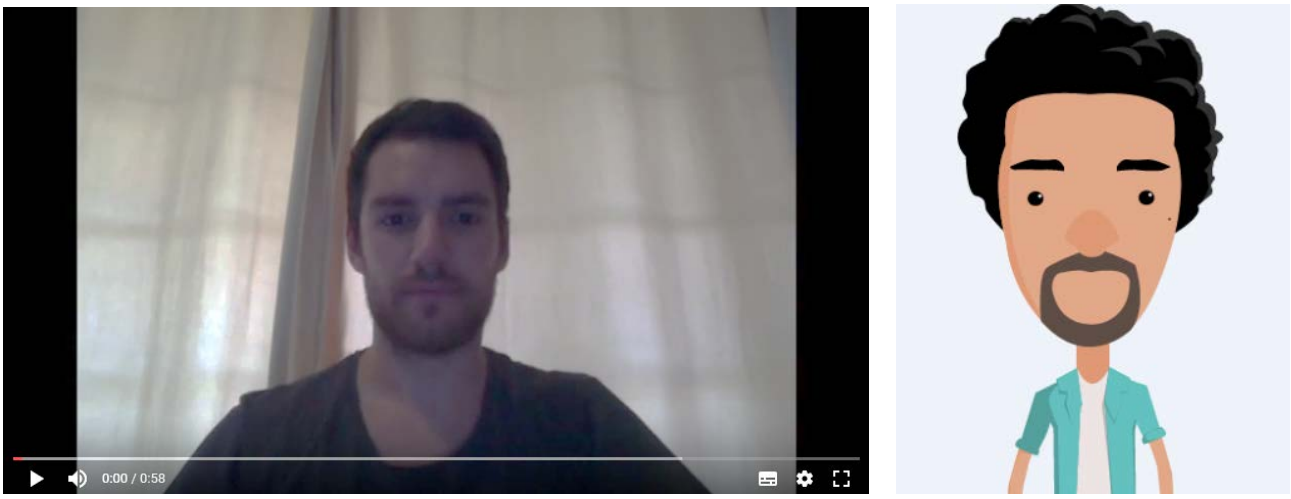

Figure 48 - The video of Nathan (left) and his cartoon depiction (right)

The video was followed by an interactive narrative placed on the landing page of the website for the first few weeks. Figure 49 shows two screens from the narrative. The image of Nathan on the left was animated to show him talking. Users could click on the links below (shown in blue) to progress to the next part of the story. All the paths led to an outcome where the users could register on the website.

Figure 49 - Two screens from the interactive narrative on the landing page of the website

A page was called Design was added to the website. On this page users could read updates posted by Nathan and view the progress of his website (as they helped to develop it). The Design page is shown in Figure 50. The way in which the users helped to develop the website was by completing quests and earning skills (section 4.4.4). This is explained in more detail below.

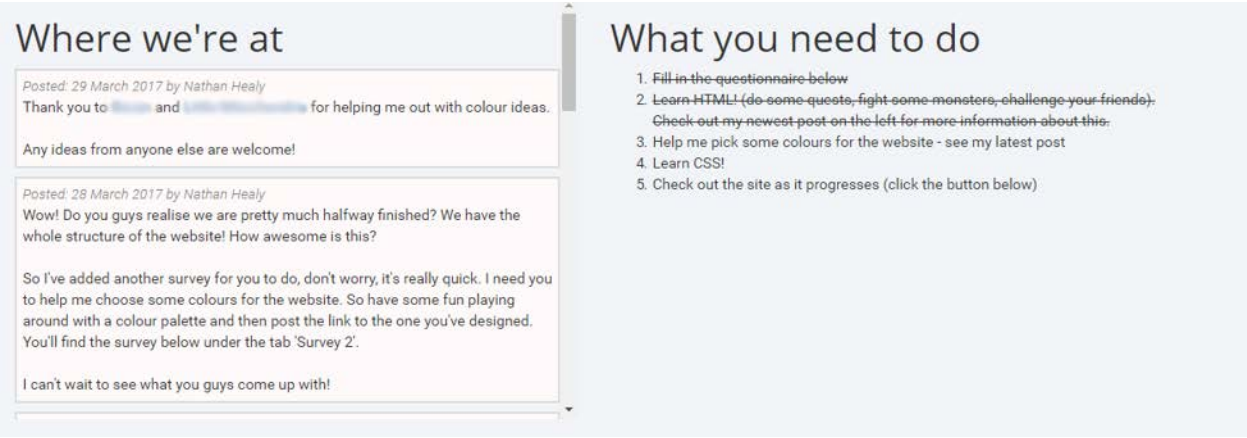

Figure 50 - The Design page where Nathan posted updates (final website)

The website that Nathan needed help developing was a fictional website aimed at selling novelty joke items. At the beginning of the semester, users were asked to complete a questionnaire which would help Nathan to understand his target audience better and plan the website properly. This questionnaire was constructed based on principles of website planning that were taught in the module at a later stage in the semester and was embedded on the website through Google forms. The purpose of including this questionnaire was to make Nathan's story more realistic as well as to introduce the students to the process of designing a website.

At a later stage, users could complete another questionnaire to help Nathan determine the colour scheme of the website. This questionnaire was released after the students were taught about adding colour to a website. The best colour scheme recommended by a user was used in the final fictional website. This would allow users to feel that their choices had meaning within the larger story. These meaningful choices would help to foster autonomy (section 2.1.3.2).

After the first survey was completed and HTML concepts began to be taught in the module, a progress bar appeared on the page. The progress bar is shown in Figure 51.

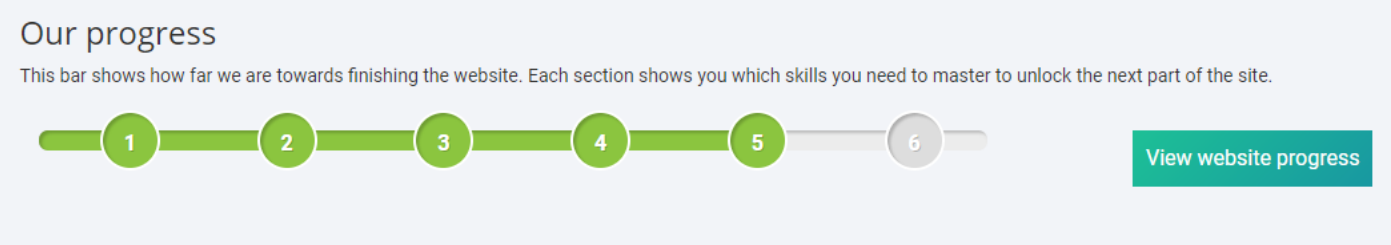

Figure 51 - The website progress bar (final website)

The bar had six milestones on it. Each milestone represented a group of skills which the user needed to attain in order to unlock the next section of the fictional website. Skills could be attained by completing the appropriate quests. When a user placed their mouse on each milestone, they could see which skills they still needed to unlock it, as shown in Figure 52.

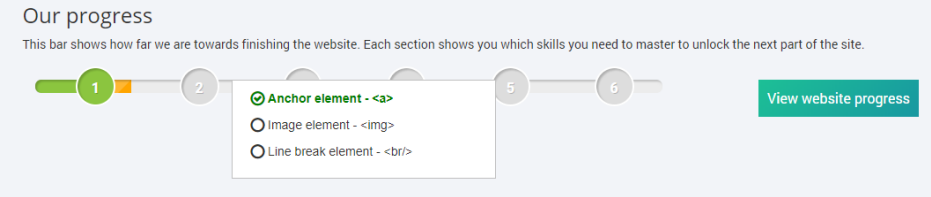

Figure 52 - The skills needed to unlock the next level on the progress bar

These milestones and skill goals were an implementation of the interim goals design lens (Table 8, 17) as they provided the users with small goals which would build up to the final goal of seeing the final website.

The user could view the fictional website at any point and it would display differently based on which milestones they had achieved. The milestones were tied-in to the content taught in the module and were in the same order as the order in which the content was taught. This meant that as a user completed quests about content they had learnt, the fictional website showed these same elements. This further exemplified the concept of situated learning. It also provided the users with a broad, general summary of their learning progress, which would foster feelings of competence.

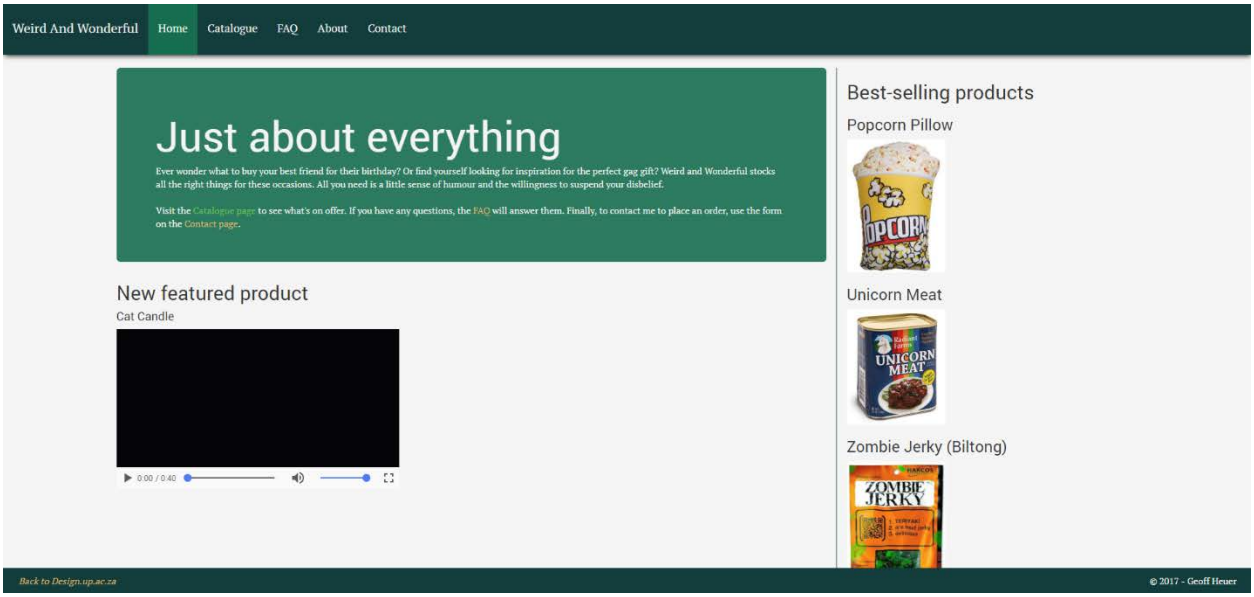

Figure 53 - The completed fictional website

Finally, a small portrait of Nathan was added to the navigation bar of the website with a speech bubble next to it (Figure 54).

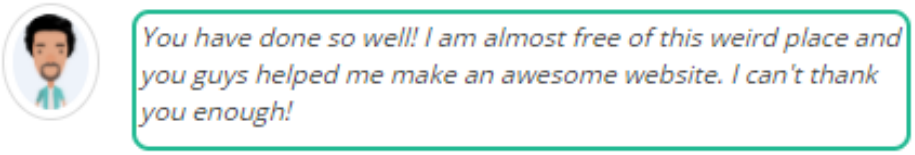

Figure 54 - The portrait of Nathan on the navigation bar (final website)

The message from Nathan would change every few weeks to adapt to what was taking place in the module and to try to encourage the users to engage with the system in order to help him develop his website.

The narrative was added to make the gameful elements on the website make sense within a context. In order to progress in the narrative and see more of Nathan's website, users had to complete quests and learn skills directly related to the content of the module.

4.4.9 Website achievements in lectures

Achievements of users on the website were highlighted during lectures (Figure 55). The lecturer would show the profile images of students who had a high level of interaction on the website. There was no specific set of criteria that was applied to choose which users to show, the website was simply examined and the most active users in the recent past were chosen. Each user featured in class would receive a special frame to use on their profile that none of the other users would have access to. Figure 55 shows an example of the class slides used to announce these awards.

These awards were added to remind the students of the broader community around the website and in doing so, foster relatedness. They were also intended to encourage website use by highlighting the fact that certain students were engaging with the website. This is an implementation of the traces of other design lens (Table 8, 23).

These achievements could still be considered intrinsic rewards even though they were awarded outside the website. This is because they were based only on actions which took place within the website and had no value in the real world (section 2.1.3.4). This means that these achievements still held to the goal of the website to be solely intrinsically motivating.

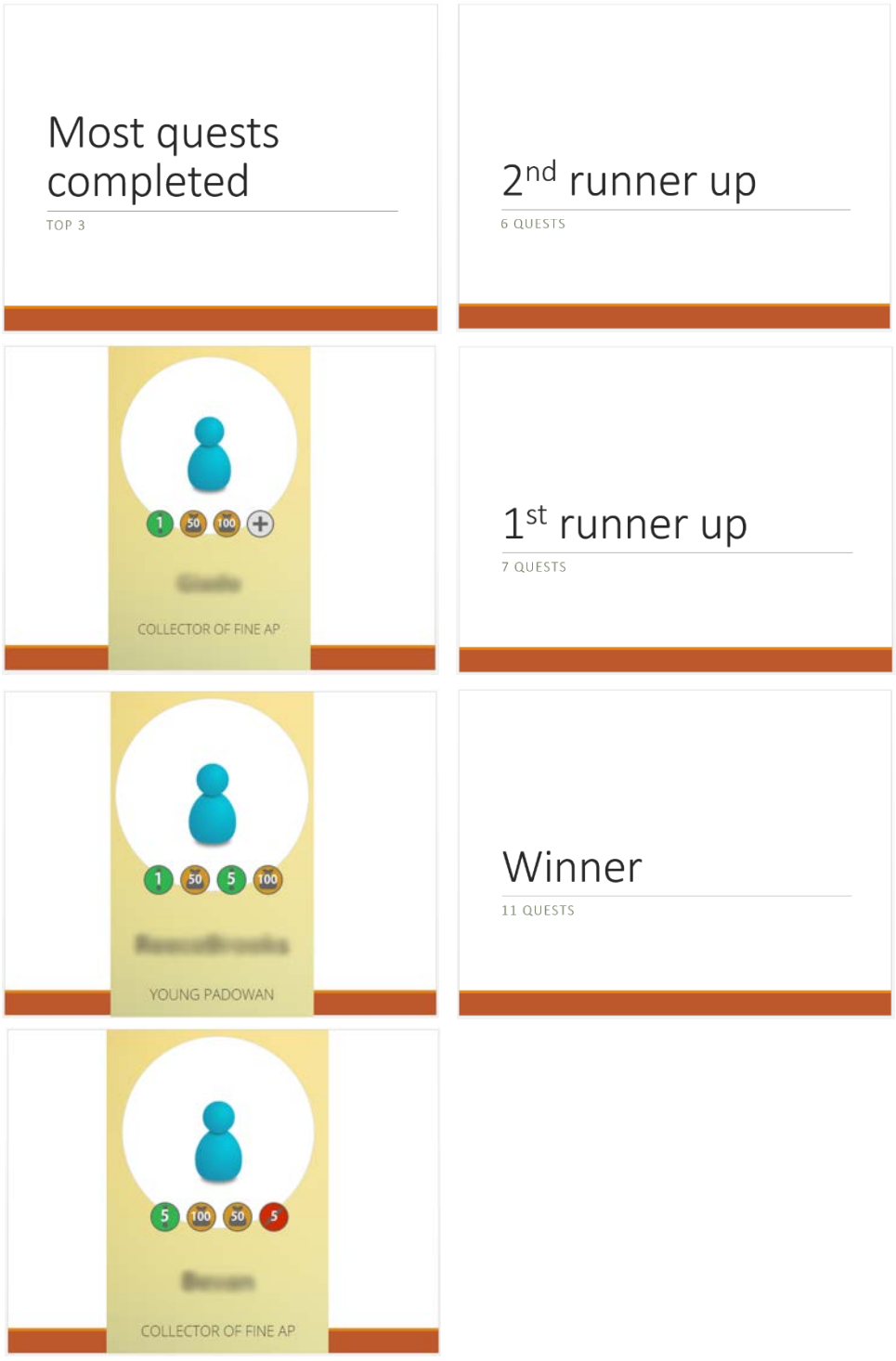

Figure 55 - An example of the slides used in lectures for the class achievements

4.4.10 General website overview

The following section provides some figures showing section of the website which have not yet been shown.

Figure 56 shows the module page where students could view announcements from the lecturer, their marks and class notes. They could also submit a question anonymously to ask for help with something they did not understand regarding the course content.

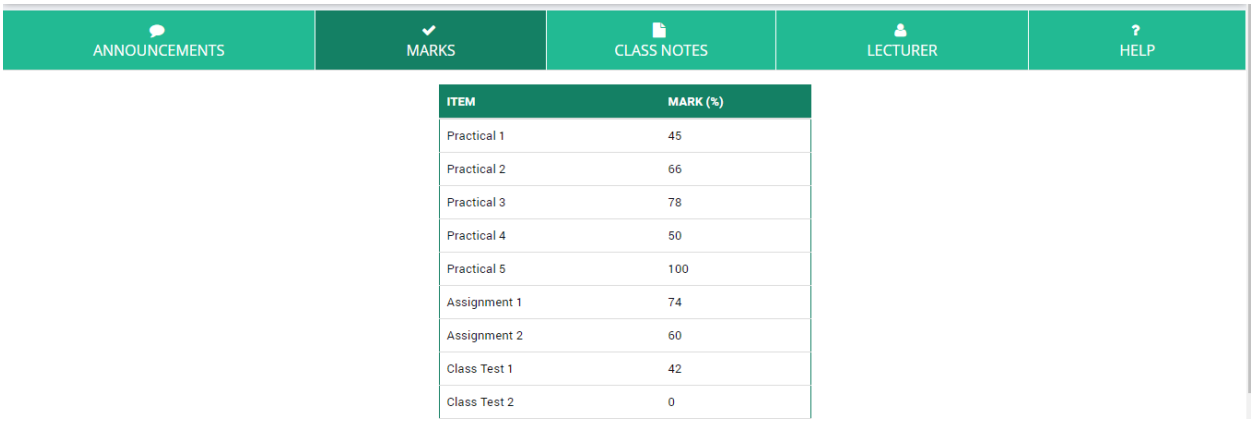

Figure 56 - The module page where students could view their marks, class notes and announcements made by the lecturer (final website)

Figure 57 shows the progress section on the home page which allows a user to view their progress on the website at a glance. Figure 58 shows the profile page where a user can view their timeline, skills and achievements earned, notifications and account details.

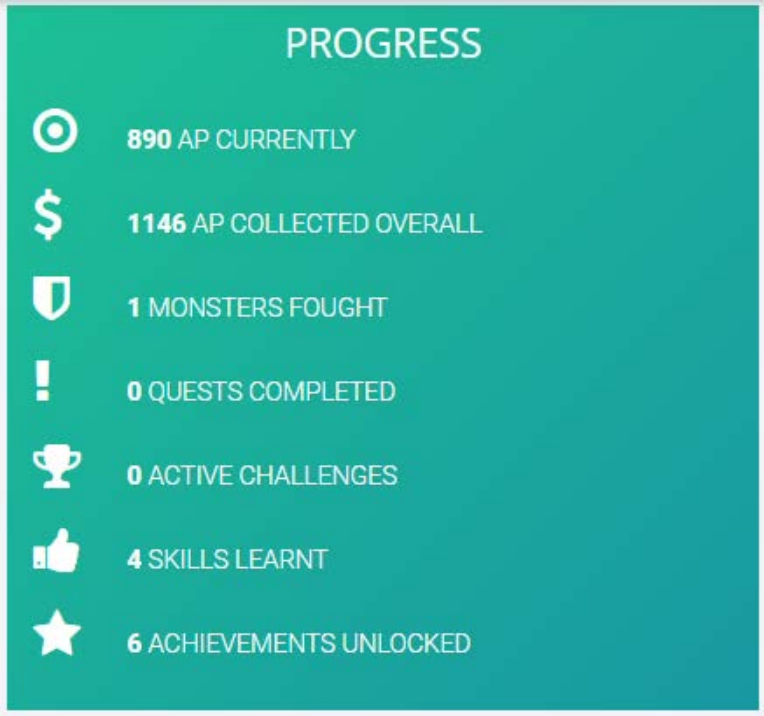

Figure 57 - The progress section shown on the home page (final website)

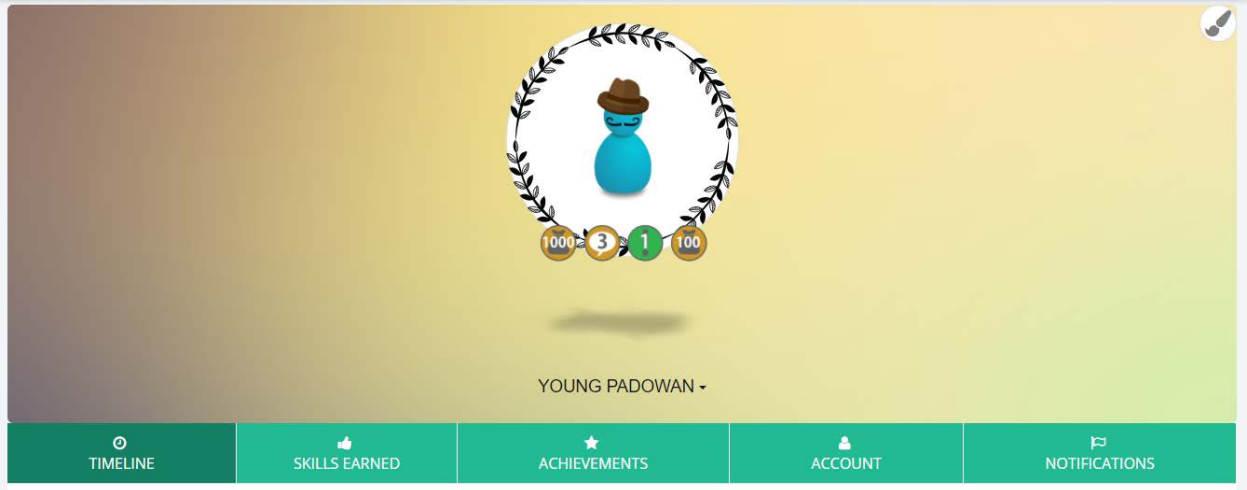

Figure 58 - The profile page (final website)

4.4.11 User needs satisfied by website elements

The final website contained a number of elements which aimed to satisfy the three basic psychological needs of the users and in that way, improve their intrinsic motivation to use the website as well as improve internalisation. This in turn, would allow for deeper engagement with the module content as well as more autonomous forms of extrinsic motivation. Each of the needs is discussed below with the gameful elements relating to it and this discussion is summarised in Table 15.

Autonomy was supported by allowing users freedom with what they could do on the website. The map allowed them to choose where to move, which monsters to fight and which quests to do. They also had a choice about how they wanted to spend their AP on the system – on map movement, on shop items or on challenging other users. Additionally, the ability to customise their avatar also aimed at supporting their sense of agency within the system.

Competence was met by allowing users to test their skills through fighting monsters and doing quests. The challenge system was also intended to aid this. Attaching skills to quests and allowing users to earn achievements and titles was a way of showing them how their abilities had improved as they engaged with the website. Lastly, the class achievement announcements and the narrative was also aimed to improving feelings of competence.

Relatedness was met through the class achievement announcements and the challenge system. The narrative was also aimed to improve relatedness as it was aimed at making the user feel like their actions mattered within a greater context.

User need	Gameful website elements
Autonomy	Map (section 4.2.1.1 and section 4.4.2)
	Choice of monsters and quests (section 4.2.1.1.3, 4.2.1.1.4, 0, 4.4.4)
	Customisation of avatar (section 4.2.2 and section 4.4.6)
Competence	Quests and monsters
	Challenge system (section 4.4.7)
	Skills (section 4.4.4 and section 4.4.8)
	Achievements and titles (section 4.2.2)
	Class achievements (section 4.4.9)
	Narrative (helping the NPC) (section 4.4.8)
Relatedness	Challenges
	Class achievements
	Narrative (helping the NPC)

Table 15 - The gameful website elements and the user needs they were intended to satisfy

4.5 Technical details

The website interface was created using HTML5 and CSS3 with JavaScript being used for the client-side functionality. The server-side functionality was handled with PHP and a MySQL server. The website was hosted on an internal server belonging to the University of Pretoria.

4.6 Summary of chapter 4

The website for this study was developed according to the Lens of Intrinsic Skill Atoms method. The gameful elements incorporated were aimed at satisfying the three psychological needs and this was done by following the principles of gameful design and self-determination theory. Every reward within the system was intrinsic in order to prevent students from engaging with the website for extrinsic reasons.

The pilot website was designed and implemented for the IMY 120 module to teach content-creation applications. Data were gathered from questionnaires and focus groups and used to improve the website so that would be better suited to meet the needs of the students. The main change that was made was to implement the final website in the IMY 110 module instead because this particular implementation of gameful design was found to be better suited to less subjective content matter. Additional changes made to the website included altering the quests, improving the monster element and adding a challenge system and an overarching narrative.

The final website was developed for IMY 110 and was implemented in the module in the first half of 2017. Chapter 5 describes the results and analysis of this implementation.

5. Chapter 5 – Results and Analysis

The previous chapter discussed the design of the gameful website. This chapter presents the results collected from the implementation of the website in IMY 110 2017 module. Data were gathered from three different sources. Each of these sources is discussed in more detail below. Following this is an integrated discussion of the results from these data and how they serve to answer the questions of the study.

5.1 Data sources

Data were gathered from four different sources – archival records (section 3.1.2.2.1.3.1) in the form of website database data and Google analytics data; questionnaires (section 3.1.2.2.1.3.2); focus groups (section 3.1.2.2.1.3.3) and finally, direct observation (section 3.1.2.2.1.3.4). Each of these sources is discussed in more detail below.

5.1.1 Archival records

Archival record data gathered were gathered from two sources: the SQL database which was used in conjunction with the website as well as Google Analytics. Google Analytics is a free tool which automatically tracks website use over time and provides tools to analyse these data.

The website was launched on 13 February 2017 and ran until 13 June 2017. All time-based data provided falls within this timeframe.

5.1.1.1 Analysis

In the case of both sources, the data were downloaded in CSV format and manipulated in Microsoft Excel. It was then formatted to create graphs which provided a clearer view of how the students interacted with the website.

The website database data were manipulated to remove the users who had deregistered from the module during the course of the semester as they did not successfully complete the module. The final number of active users defined by the database data was 34.

5.1.1.2 Evidence provided

The website data primarily provided evidence for the frequency of use of the different parts of the website.

Figure 59 shows the comparison of HTML and CSS quests successfully completed over the course of the semester.

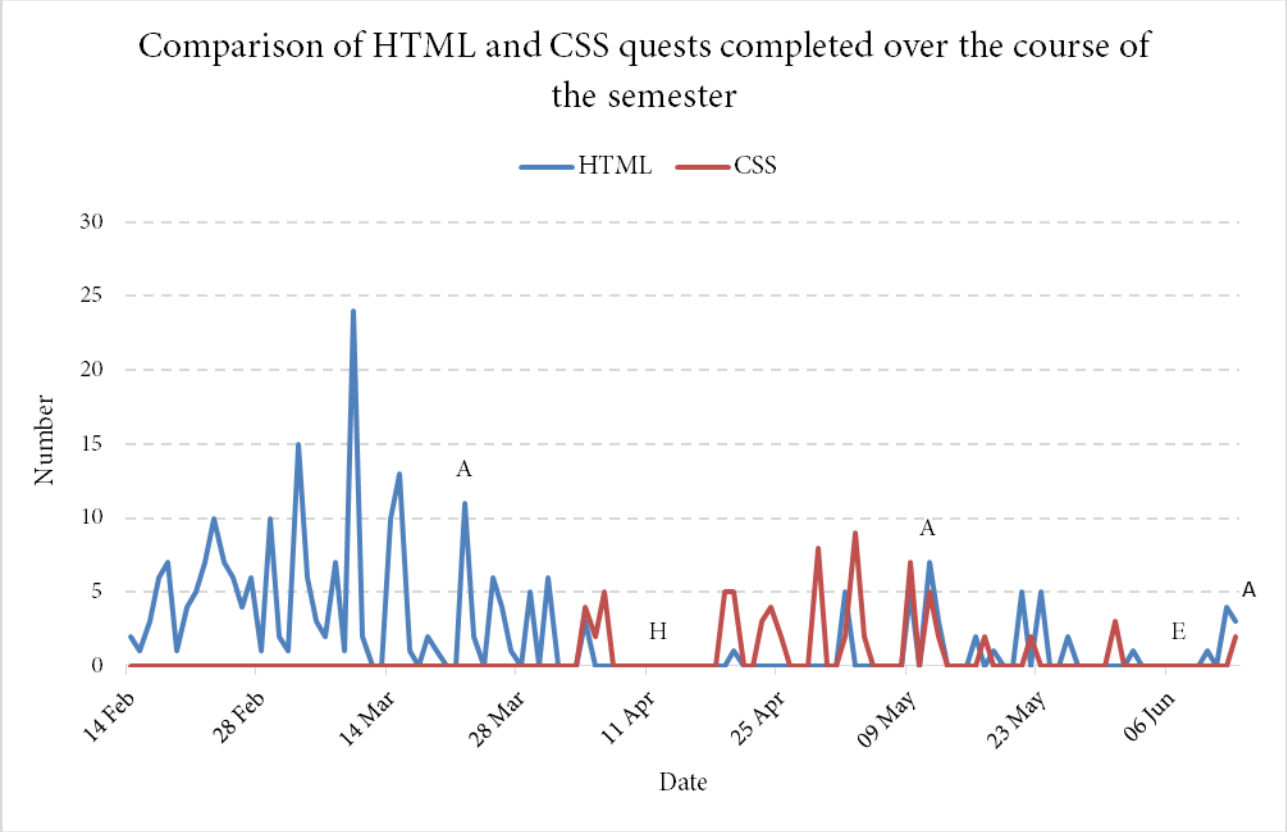

Figure 59 - Line graph showing a comparison between the number of HTML quests and the number of CSS quests completed over the course of the semester (n = 34); source: website database

Instances of "A" marked on the graph indicate formal module assessments – two semester tests and a final examination respectively. The area marked with "H" indicates the mid-semester holiday and the area marked with "E" indicates the examination period. From this graph, it possible to see that HTML quests were more popular than CSS quests, and that the most quests were completed at the beginning of the semester. A possible reason for this is the novelty of the website at the beginning of the semester and the fact that students had more free time to engage with the website. HTML quests were released first since this content was taught first in the

semester. The students also did not complete quests during the holiday or examination periods, except a few days before the final examination. The spikes of activity visible at the points marked with "A" show that students understood the value of the quests in helping them to prepare for assessments. The quests were designed with this intent in mind (section 4.2.1.1.4).

Figure 60 shows the comparison of monsters fought and quests completed over the course of the semester.

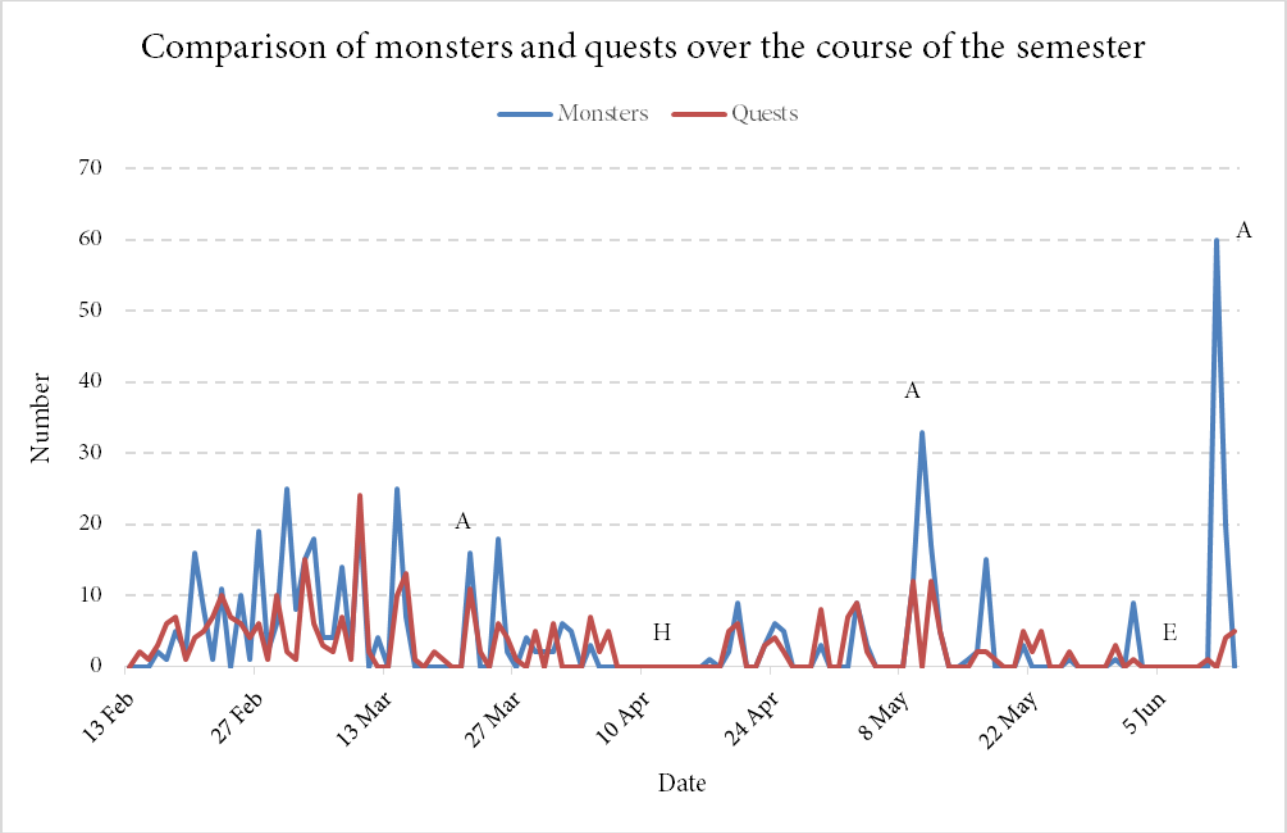

Figure 60 - Line graph showing a comparison between the number of monsters fought and the total number of quests (HTML and CSS) completed over the course of the semester (n = 34); source: website database

From this graph it is clear that monsters were more the more popular element to engage with. This is most likely because they were less time consuming to complete. It might also have been due to the addition of the playful element of the monsters and their descriptions (section 4.3.1.3) which served to make the monsters more interesting than the quests. From the graph it is also possible to see that, like the quests, students understood that the monster (quiz) element was

helpful for assessment preparation (indicated as "A" on the graph). This is especially true concerning the final module examination as is evidenced by the spike of activity shown on the far right-hand side of the graph. The monster element was designed to allow students to test themselves on the theory of the course content (section 4.2.1.1.3) and this graph shows that the students used it for this purpose.

Figure 61 shows the combined interaction of monsters and quests (a combination of Figure 59 and Figure 60).

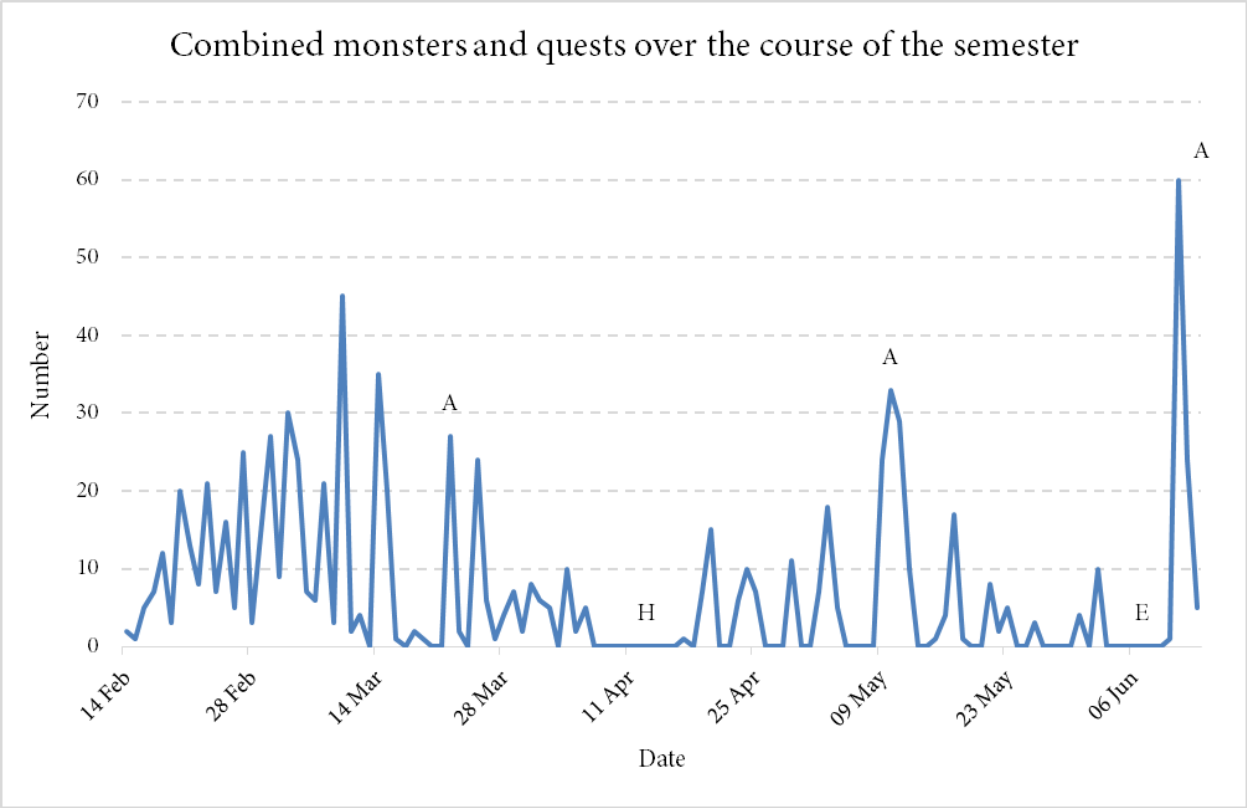

Figure 61 - Line graph showing the combined interaction of all monsters and quests over the course of the semester (n = 34); source: website database

From this graph the general trend of interaction with the skill-based components of the website can be seen. Interaction at the start of the semester was higher than interaction after the holiday (marked as "H"). High levels of interaction just before the final examination again support the conclusion that the students found these components valuable in helping them to prepare for assessments and therefore these components made them feel more confident with the course content. This is discussed in more detail in section 5.2.1.1.

The website data also show that the shop was not very popular, with each user buying two items on average and only 49 sales being made throughout the semester. 23 (64%) users bought at least one item from the shop.

The challenge section was also not widely used. Only ten challenges were issued throughout the semester and all were issued by the same user. Possible reasons for the lack of engagement with the shop and challenge elements are discussed in section 5.2.3.

Figure 62 is sourced from the Google Analytics data. It shows the average session duration of all users over the course of the semester.

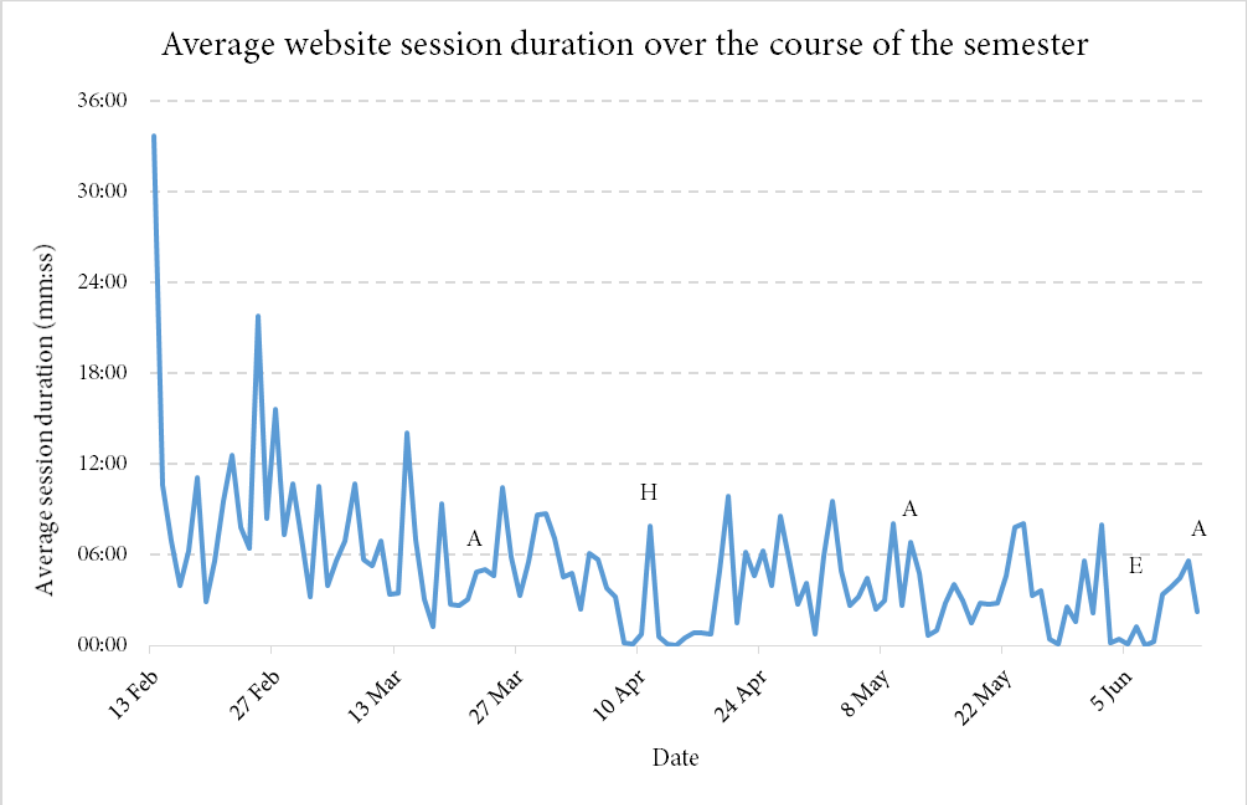

Figure 62 - Line graph showing the length of an average website session over the course of the semester (n = 34); source: Google Analytics

A session is a set of interactions between a user and the website over a given time frame. Google Analytics measures a session from the moment the user arrives on the website until they close the browser, navigate away from the website or spend longer than 30 minutes inactive on the website. From Figure 62 it is possible to see what was also shown in Figure 61 – website activity decreases as the semester progresses. What is interesting to note is the length of the initial sessions on the website. This indicates interest in the gameful parts of the website as there were

no compulsory module assessments at that time. It can also be seen that during the holiday (marked as "H") and exam period (marked as "E") there is website activity but no interaction with the quests or monsters (Figure 61). This probably means that students were using the website for admin purposes during this time.

Figure 63 shows how long the average website session lasted on each day of the week. It shows that Tuesday and Saturday were the days on which the most time was spent on the website.

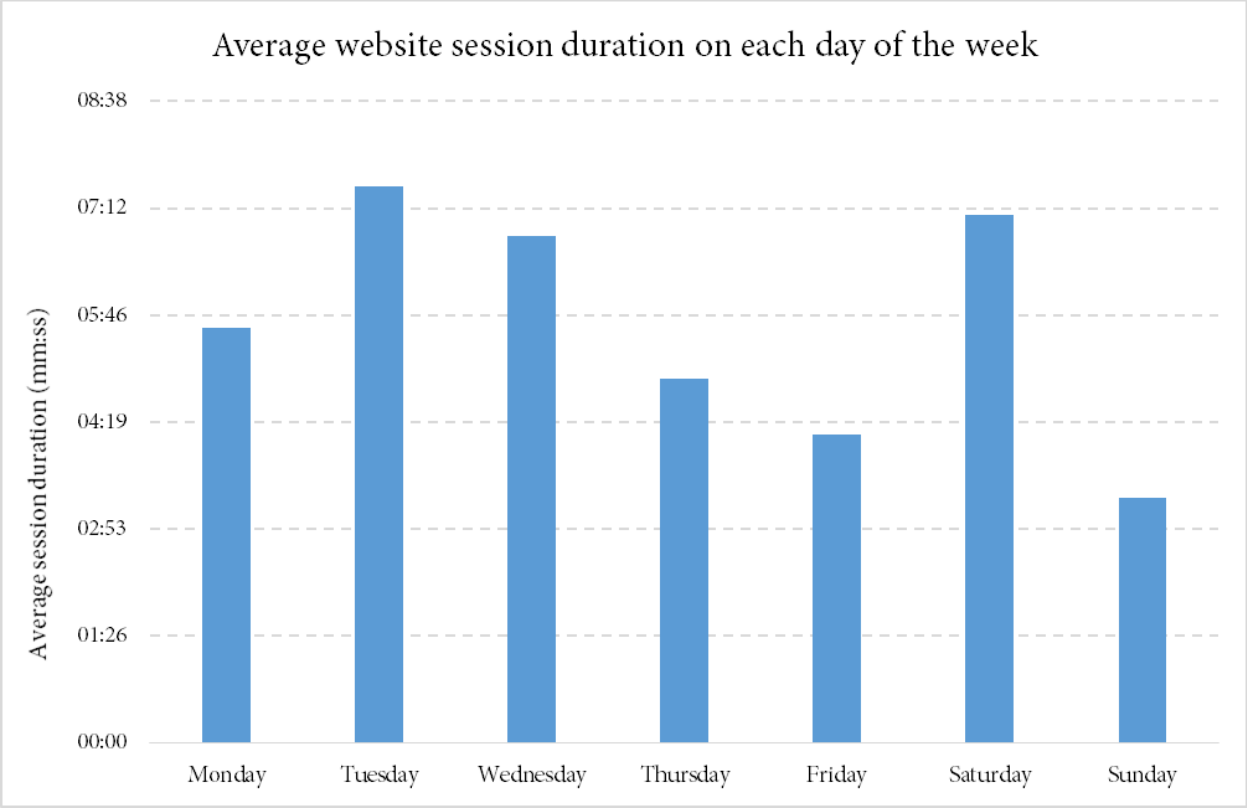

Figure 63 - Bar graph showing the length of an average website session on each day of the week (n = 34); source: Google Analytics

Tuesdays were the days when the students had a practical assessment in the computer lab; therefore it makes sense that this would be the time when they would be most engaged with the website. However, the data for Saturdays are interesting because they show that students spent time on the website over their weekends, which is to be considered free time. Since it is possible that the students were simply on the website for the purpose of completing compulsory module activities such as assignments, Figure 64 shows the combined interaction of quests and monsters over every weekend throughout the semester.

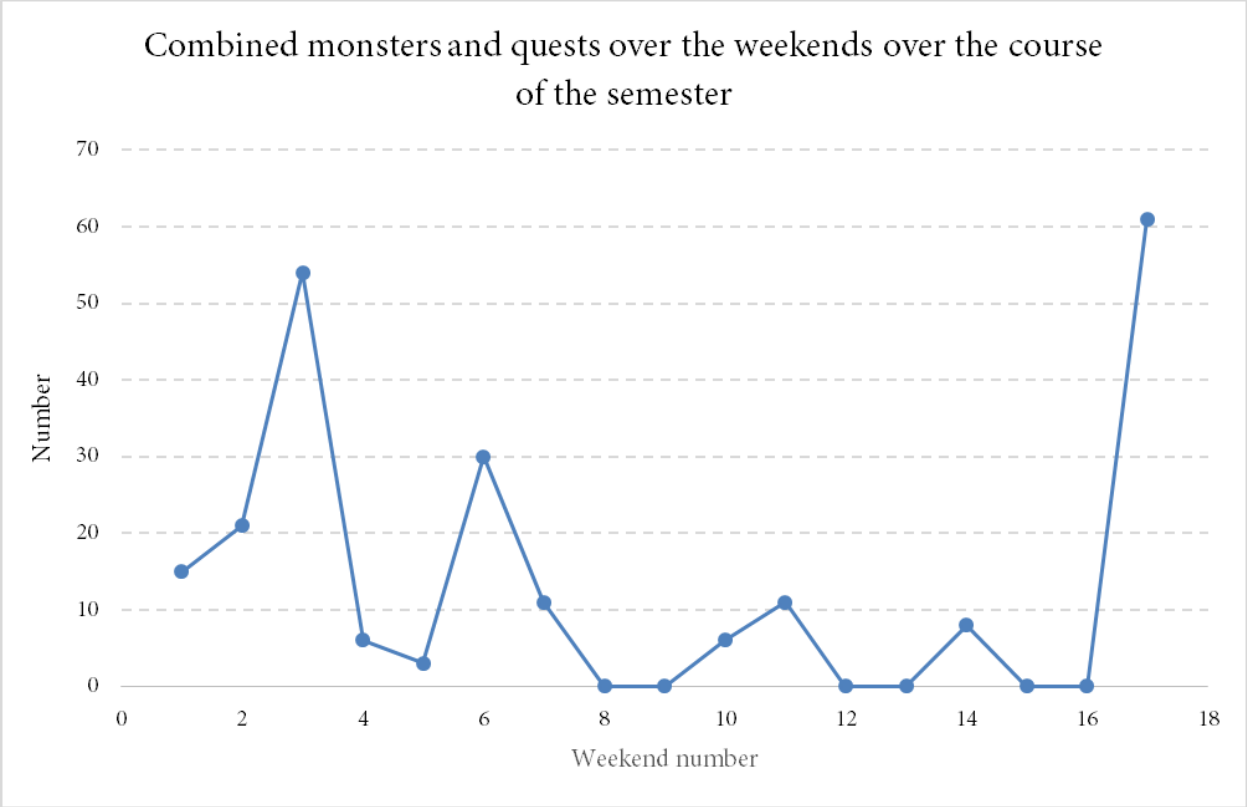

Figure 64 - Line graph showing the combined interaction with monsters and quests over each weekend over the course of the semester (n = 34); source: website database

Here it can be seen that some of the weekend interaction with the website did consist of engagement with the gameful elements. This is discussed in more detail in section 5.2.1.4.3.

Figures 51 to 54 and Figure 64 are represented as line graphs. This is because the data consist of activity over a period of time. A line graph accurately shows the level of activity over the course of the semester. A bar graph was chosen for Figure 63 because it makes it possible to show the values of various categories (days of the week) to allow for a comparison between these categories.

5.1.2 Questionnaires and focus groups

The primary sources of data for this study were the questionnaires and the focus groups. Each of these sources is discussed separately below, followed by a description of the analysis performed on the combined data of these sources.

5.1.2.1 Questionnaires

Questionnaires were administered to the website users during the last lecture of the semester before the final exam took place. They were in an electronic format using Google Forms. The questionnaire was completed by 28 out of a possible 34 students registered for the module. The six students who did not complete the questionnaire did not attend the lecture during which it was administered. The full questionnaire can be found in Appendix A. The process of administering the questionnaires is discussed in more detail in section 3.1.2.3.1.3.

The data gathered by Google Forms were exported in Microsoft Excel format. The questionnaire contained both qualitative and quantitative data. The quantitative data were manipulated in Microsoft Excel to create graphs which would support the qualitative data.

5.1.2.2 Focus groups

Nine users participated in the focus groups and they were divided into two groups. The first group contained five users who had indicated a high level of participation with the website. The second group contained four participants who indicated lower levels of participation compared to the first group. The focus group process is described in detail in section 3.1.2.2.2.3.

The sessions were recorded using audio recording equipment. These recordings were later transcribed and the analysis of these data is described in the following section. The questions asked during the focus groups are supplied in section Appendix B.

5.1.2.3 Analysis of focus groups and questionnaires

The qualitative data from both the questionnaire and the focus groups were imported into ATLAS.ti, a qualitative data analysis program. Using ATLAS.ti, the data were coded according to the process discussed in section 3.1.2.2.3.1.

The data were read through once to gain a thorough understanding of it. The second time, open coding was done by defining categories and attaching them to data elements. Once all the data had been coded, axial coding was performed by examining the data once more and fleshing out the categories as well as relating them to each other. Finally, selective coding was done using the Networks feature of ATLAS.ti to integrate the categories in order to form a theoretical outline of the data.

5.1.3 Direct observation

Direct observation was intended as a supplementary data gathering technique. It was possible to collect data this way because the researcher was also the lecturer for the module in which the website was implemented. It was collected informally when the lecturer had direct interaction with the students, such as during lectures and practical times. The process is discussed in more detail in section 3.1.2.2.2.4.

5.2 Integrated evidence

The following section provides an integrated, in-depth view of data gathered from all sources. It is primarily informed by the coding done on the interview data. In order to provide a holistic view of what the data show, it is necessary to discuss all sources in an integrated manner.

5.2.1 Facilitating motivation

Self-determination theory (section 2.1.1) is concerned with both intrinsic and extrinsic motivation. It examines these concepts through two mini-theories: Cognitive evaluation theory (section 2.1.1.2.1) which deals with the factors which influence intrinsic motivation and organismic integration theory (section 2.1.1.2.2) which concerns the factors which influence extrinsic motivation. Both types of motivation are facilitated and improved through the satisfaction of the three basic psychological needs (section 2.1.1.1). The gameful intervention which was designed for this study uses concepts from game studies and gameful design to facilitate these needs in an attempt to improve the motivation of the students toward the course content.

The following section discusses the data gathered from the study in the context of the motivation theories mentioned above in order to determine whether the website was able to satisfy the three needs and in doing so, improve the motivation of the students.

5.2.1.1 Competence

The need to feel effective in one's interactions with the environment (section 2.1.1.1.2) is the primary need which is met by well-designed games due to the carefully crafted challenges that they provide (section 2.1.3.1). The following section shows how gameful design is able to meet this need in the same way.

The quests and the monsters were the primary way that the website was designed to satisfy competence (section 4.2.1.1.4 and section 4.2.1.1.3). The map (section 4.2.1.1) facilitated this by

making the process more interesting and by adding value to AP (which was the reward for doing quests and fighting monsters).

The following section addresses how the website affected the students' engagement with the content, the amount of practice they did and how they understood the content.

5.2.1.1.1 Engagement, practice and understanding

In a general sense, the website positively affected the students' perception of the module as a whole. 26 (93%) of questionnaire respondents felt that it made the module more engaging for them (Appendix A, question 51), providing some of the following reasons:

> *"It made it more personal and involved. It made it more interesting and fun."*

> *"Being taught solely out of a textbook or slides tends to become boring, but allowing students to revise their work and track their progress in a fun way makes the module more engaging."*

From the remaining 2 respondents (7%), one respondent said they did not engage with the optional parts of the website, and the other said that the elements were not suited to them because they were not competitive.

In addition, 24 (86%) of questionnaire respondents said that the website made the work easier to understand (Appendix A, question 55) and that it made them more excited about the work in general (Appendix A, question 57), as is indicated by the following quotation from the questionnaire:

> *"Seeing the work as a quest and exploration changes the perception from learning to having fun."*

The remaining 4 respondents (14%) explained that they did not use the website very often and therefore it did not have an effect on their view of the course content.

In terms of making the work easier to understand, the data showed a number of different ways in which the website helped the students with the work in the module. Firstly, the monsters and quests provided them with an opportunity to practice the work they had learnt, and the monsters specifically provided repetition which students found valuable:

> *"You put all that you learn into practice."*

> *"The explore feature made it easier as it was repetition of the work."*

"Revision. Revision. Revision, but through a game."

This opportunity to practice was the primary reason why the monster and quest elements were included in the website (section 4.2.1.1.3 and section 4.2.1.1.4). Allowing the students the freedom to fail (section 2.4.4.2.1) at these tasks was what made the repetition possible.

The monsters and quests also allowed students to test their knowledge of the content which helped them to prepare for assessment. This allowed them to feel more confident about upcoming assessment opportunities:

"It helped me a lot to study for the test, I found the most difficult monster and fought him 50 times and studied the answers."

"Fighting monsters just before a test really helped with understanding the material."

"I remember specifically before our first semester test I was really stressed so I sat in like the yellow lab and did a ton of quests. And like so many of the short questions were in the quizzes and I was like, 'yes!'"

The use of these elements to prepare for assessment is also discussed in section 5.1.1.2. Figures 50 through 53 also show a trend of these elements becoming less used as the semester continued. A number of questionnaire respondents and focus group participants quoted a lack of free time as their reason for not engaging with these elements more often. In addition, it is also likely that after the initial novelty of these features wore off, the students also used them less often.

A less dominant theme which emerged was that the way the website separated the content into manageable pieces through the quests made it easier and less intimidating to learn:

"…studying is kind of boring, but then if you have like a small chunk of work that you can do, like a quest, it's like easy to jump in, get it done, know that you understand a specific concept and then move on."

This statement shows that there was value in designing the quests and monsters to support small, short interactions (section 4.2.1.1.3 and section 4.2.1.1.4) as it made it "easy to jump in" which means it is easier for users to begin engaging with these elements.

The mention of "knowing" that one understands (in the quotation above) is a concept that speaks to the importance of feedback in fostering competence (section 2.1.3.1). Another participant described how this feedback allowed them to correct their mistakes. This is the

concept of freedom to fail (section 2.4.4.2.1) and it was the reason why there were no negative repercussions if a student failed to beat a monster or complete a quiz correctly.

In summary, the additional gameful elements, specifically the monsters and the quests, provided the students with opportunities for repetition and practice. They were also able to engage with these elements as a means of testing their own knowledge and improve their understanding, which helped them to prepare for assessment. The separation of the content and the feedback provided for quests was also found to be helpful in this regard.

5.2.1.1.2 Competence concerning module content

Figure 65 shows the students' opinions of the effect of the website on their feelings of competence regarding the module content.

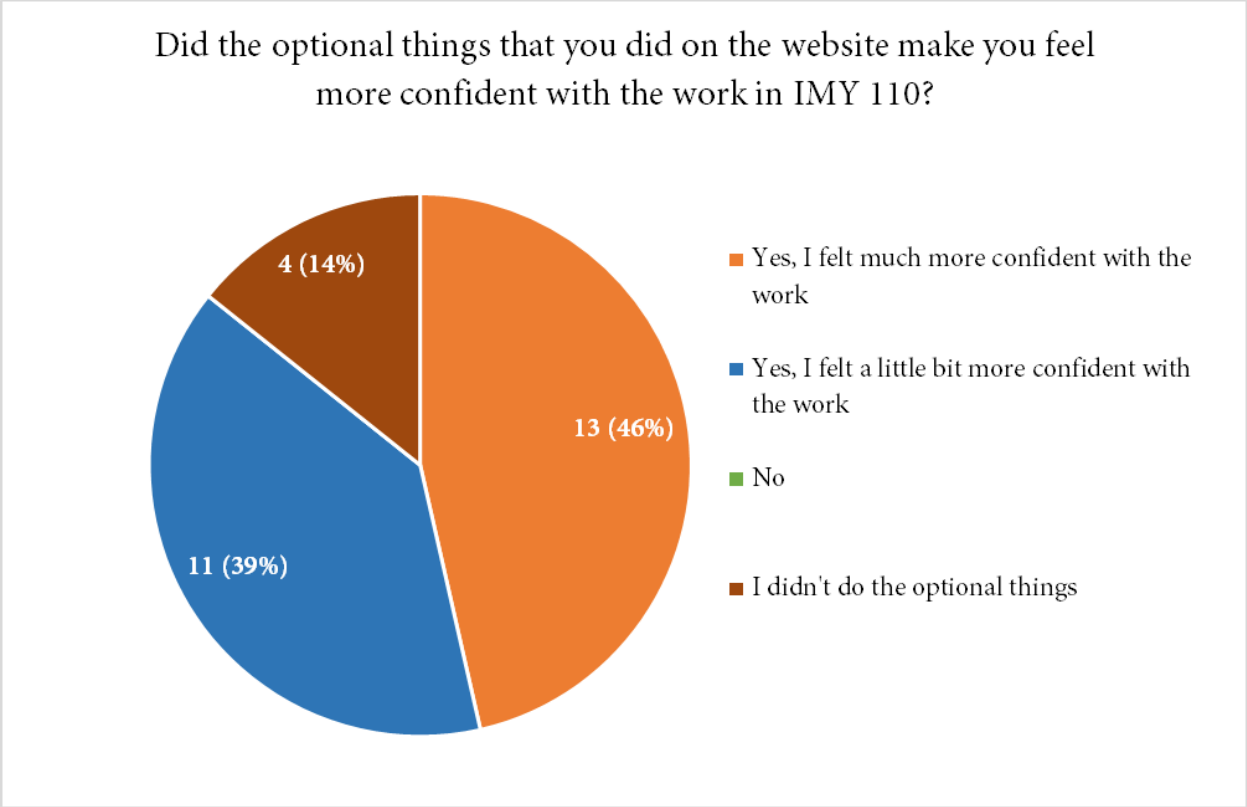

Figure 65 - Pie chart showing the effect of the optional, gameful parts of the website on the students' confidence with the course content (n = 28); source: questionnaire (Appendix A, question 49)

From these data it can be seen that students who interacted with the website had their need for competence satisfied in varying amounts. A number of reasons were provided for the website

having this effect. They included the fact that the website allowed students to test their knowledge before assessments as well as to practice the skills that they had learnt:

> *"The extra knowledge that I was able to [sic] these optional things helped boost my confidence in tests."*

> *"It confirms that I know things."*

The second quotation speaks to the ability of the website to bolster students' confidence in their own abilities. A reason provided by another respondent describes the power of the concepts of freedom to fail and free choice in aiding feelings of competence:

> *"I have numerous chances to try something until I got it right, without feeling pressured."*

Participants in the focus groups agreed that the gameful parts of the website made them feel skilled in the module content (section Appendix B, question 8). Focus group 1, in particular, mentioned that their feelings of confidence in the work grew because of the website and that they felt more in control of the subject matter and less overwhelmed by it.

The gameful elements that contributed to feelings of competence were primarily the map, monsters and quests. This was because these elements allowed the students to test their knowledge of the content through the challenge of a quest or a monster. These challenges, when overcome, gave rise to feelings of competence. The following quotations illustrate this point:

> *"[A quest] was like a summary test to test my knowledge. It was especially effective because it tested my knowledge one small bit at a time; I felt more confident and comfortable and not overwhelmed."*

> *"Extra quizzes definitely made me feel more confident."*

> *"[The map] was interesting, a lot a fun and challenged my HTML and CSS abilities."*

> *"[I fought the monster] to see if I can beat the monster with my knowledge."*

The map also provided positive feedback by showing students how much progress they had made. Being able to see this progress showed the students that they were learning and improving:

> *"The map also kind of gave a visualisation of like, goals…wanna [sic] maybe complete the map, or there's a quest, let me go find it and do it. Short term goals that you can achieve and then you feel like, like you said, 'I'm doing something, I'm learning something.'"*

This is what was intended by adding the key to the map which showed users how much they still had to find (section 4.2.1.1).

Similarly, the achievements system did the same for some students. 19 (68%) of the questionnaire respondents provided positive feedback towards the achievements (Appendix A, question 43):

> *"I think to me [elements that inspired confidence were] more like achievements. Cos the more you do stuff, the more feedback you get about and you get your badges and your little— you'll see that, hey I'm actually really making an impact in terms of what I'm learning, but also in terms of what the website offers."*
>
> *"The achievements were a nice way to know that I'm accomplishing something."*
>
> *"I felt very proud and it made me more confident in my work."*
>
> *"This was a very good mechanism. Getting feedback at the progress I make gives a sense of pride and motivation to work harder."*

The achievements and the map as a measure of progress can be considered competence-focused feedback, which enhances intrinsic motivation (Ryan & Deci 2017:128). The remaining questionnaire respondents did not give negative feedback concerning achievements, but the majority of them explained that they were unaffected by the feature.

5.2.1.1.3 Interesting competence-related data

An interesting interaction to take note of was the fact that some students assigned goals and challenges to the map that they had crafted for themselves. This included the desire to reach the bottom of the map or to uncover every single block. These can be considered optimal challenges (section 2.1.1.1.2), challenges which allow people the chance to exercise and stretch their abilities (Ryan & Deci 2017:152). Intrinsic motivation occurs spontaneously in these situations assuming that the feelings of mastery (competence) are accompanied by some degree of autonomy. The free choice available to the students in the use of the map meant that there was no external pressure and thus, autonomy was satisfied (this is discussed more thoroughly in section 5.2.1.2). The following excerpt from focus group 2 illustrates that the goal of reaching the bottom of the map is intrinsically motivated since the students had no extraneous reason for trying to do so:

Interviewer: Did everyone try and get to the bottom of the map. Was that the—
Participant 1: Yeah.
Participant 2: Yeah.
Interviewer: Why?
Participant 2: Because. It's the bottom of the map.
Interviewer: Okay cool, so you want to get to the bottom?
Participant 1: Of course.

Another focus group participant told the story of trying to reach the bottom of the map, and in doing so, being motivated to study ahead by herself so that she could challenge the monsters and do the quests which covered content which had not yet been covered in class. This is a good example of the website eliciting intrinsic motivation.

Another possible reason why students were interested in reaching the bottom of the map is due to the task-inherent feedback it provided (section 4.2.1.1). Uncovering blocks on the map became feedback in and of itself which was satisfying and encouraged further engagement.

5.2.1.1.4 Summary of competence

The gameful elements, especially the map, quests and monsters, made the content more engaging to the students as well as easier to understand. This is because it provided them with opportunities to practice the content. It was also divided into smaller, more manageable parts which made it less overwhelming. This contributed to feelings of competence. In addition, the freedom to fail and the feedback provided also made students feel more competent.

Lastly, the map, monsters and quests provided optimal challenges and facilitated the creation of students' own goals within the system. Additionally, the map and achievements provided competence-based feedback.

In order to improve intrinsic motivation, feelings of competence must be accompanied by a satisfaction of autonomy. This is explored in the following section.

5.2.1.2 Autonomy

Autonomy is the need to experience one's behaviour as volitional and self-endorsed (section 2.1.1.1.1). This also means that actions extend from an internal perceived locus of causality (section 2.1.1.1.1). The primary way in which the website fostered autonomy was to allow each student to make their own choice of gameful elements with which to engage. This was made possible by the fact that the gameful parts of the website were optional to use (section 4.1).

When asked whether they felt pressured to use the optional parts of the website (Appendix A, question 47), 20 (71%) of questionnaire respondents replied that they never felt pressured. Figure 66 shows these data.

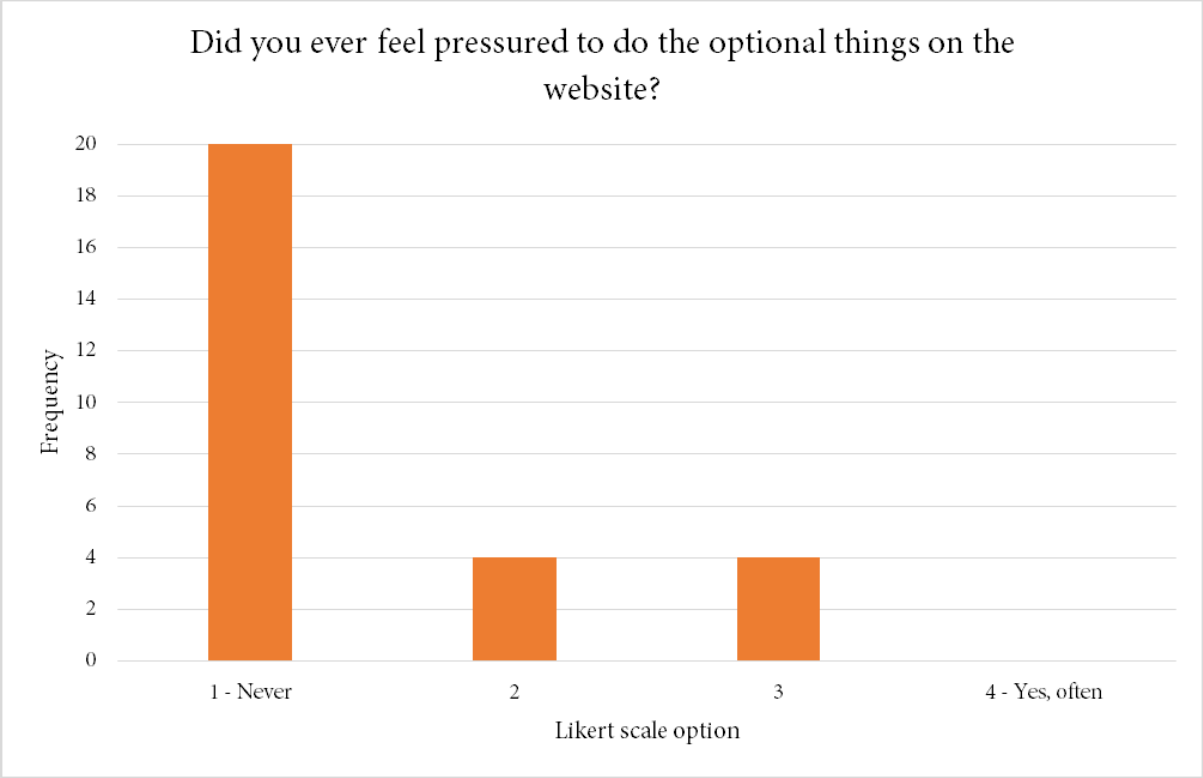

Figure 66 - Bar graph showing whether or not students felt pressured to engage with the optional parts of the website (n = 28); source: questionnaire (Appendix A, question 47)

Responses provided as a justification for this answer included the following quotations:

"It is up to you if you want to increase your knowledge of the subject it is not forced upon you."

"It was always left as a choice we could make for ourselves."

"I always did it out of own will [sic] and it was fun and educational."

"I didn't feel pressured at all; I just wanted more AP."

Reasons for answering with a value of 2 on the Likert scale were concerned with a motivation to use the features of the website:

> *"I didn't feel pressured, I felt motivated. One could learn all the work from the textbook, but it was actually fun to do the quests on the website."*

> *"I like to fight monsters."*

The responses above suggest that these students were driven to participation by their own motivation to use the website. The pressure that they reported was not viewed as negative.

Reasons for answering with a value of 3 were concerned either with pressure that students placed on themselves due to comparison with the achievements of their fellow classmates, guilt for not attempting to use the extra features or a lack of AP driving the student to continue to engage.

The fact that the majority of the students did not feel any pressure to engage shows that they were mainly acting out of an internal perceived locus of causality. This lack of pressure leads to two main outcomes. Firstly, it speaks to the freedom of choice (section 2.4.4.2.4) provided by the website. The map especially allowed choices by providing users with the freedom explore and choose their own way to navigate through it:

> *"It was entertaining and interesting to see all the new path ways and how everything connects."*

Further evidence of choices is the creation of personal goals mentioned in section 5.2.1.1.3. Students who aimed to reach the bottom of the map, uncover every block or save enough AP to buy a specific item in the shop (see below) felt enough autonomy within the system to make their own choices as to how to interact with the various gameful elements. This is also evidence of students acting out of an internal perceived locus of causality because they pursued goals not provided by the system; goals created by themselves for themselves.

Secondly, the lack of pressure provided autonomy-support by allowing the students to take responsibility for their own learning. This is evident because the data show that the students understood the value of the website in helping them to master the content of the module and used it to help them prepare for assessments (discussed in section 5.2.1.1.1). Additionally, acknowledging signs of effort and mastery also provides autonomy support (Ryan & Deci 2017:368), and this was done through achievements. One questionnaire respondent had the following to say about the achievements:

"I felt really cool, as if I was actually learning things (which I was)."

This acknowledgement was also included in a smaller way in the lecture awards (section 4.4.9). One focus group participant commented that these were helpful because students were recognised for the effort they had put into the website.

The profile customisation feature of the website also supported autonomy by allowing students to express their individuality and to build a deeper personal connection with the website. As described in section 4.4.6, this was the goal of the customisation feature of the website. The impact of this section was greater on some students than others. Figure 67 and Figure 68 show the opinions of the questionnaire respondents regarding these features.

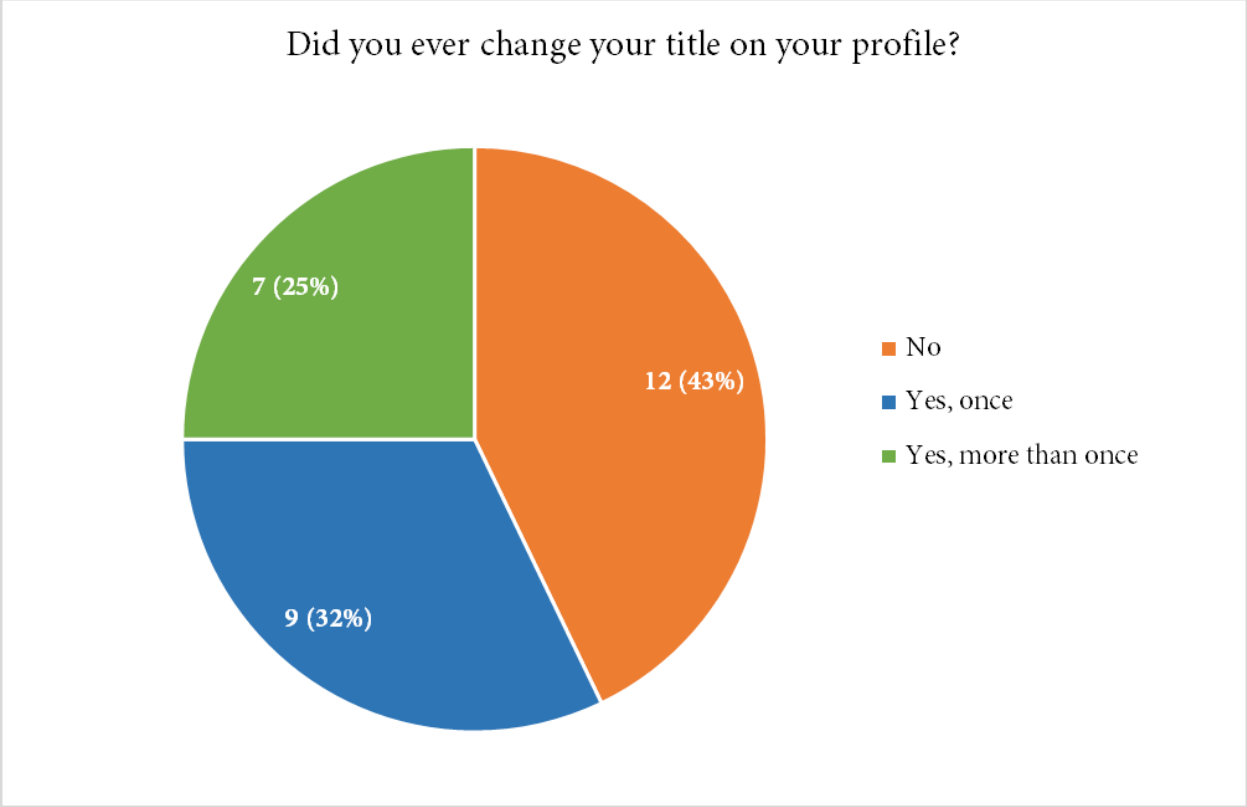

Figure 67 - Pie chart showing how often students changed their titles on their profiles (n = 28); source: questionnaire (Appendix A, question 39)

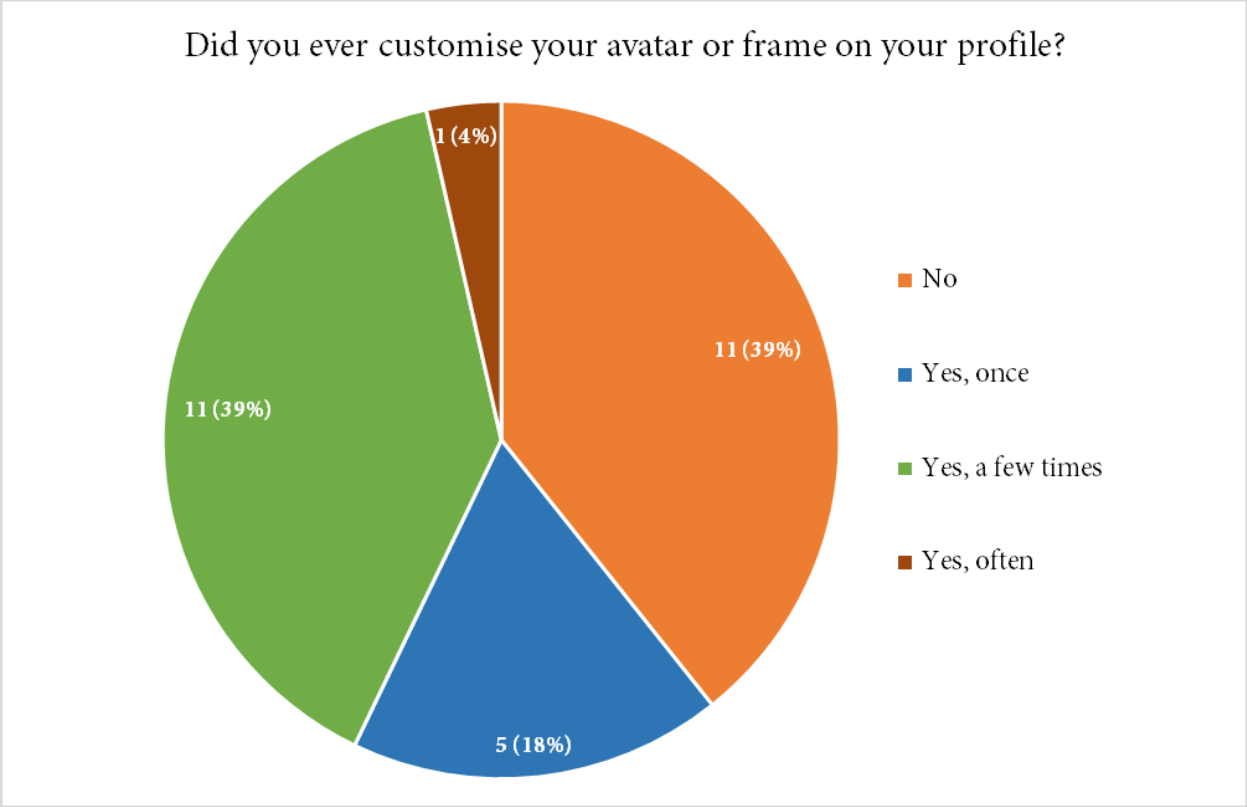

Figure 68 - Pie chart showing how often students customised their avatar or frame on their profile page (n = 28); source: questionnaire (Appendix A, question 41)

The students unaffected by these features gave reasons (Appendix A, question 42), such as:

> *"I didn't see a reason why I needed to."*

> *"I personally felt like it was unnecessary."*

> *"I chose to spend my AP on the map rather than the store."*

Evidently, some students did not feel attracted to the customisation features offered, while others wanted to save their AP to engage with other parts of the website. Those students who did update their titles and avatars provided the following reasons for doing so:

> *"Just had to give him an awesome mustache [sic] even tho [sic] it was all my AP, I have no regrets..."*

> *"I wanted to look like Indiana Jones!"*

> *"I wanted on the [sic] suited me and my personality."*

> *"It was nice being a character that only existed on the internet and have a look that suited me and my personality."*

These reasons describe how the customisation features of the website allowed the students to express their own personalities through their digital representations (section 2.1.3.2).

In summary, students did not feel pressured to engage with the optional content of the website. The map and their self-defined goals are evidence of action choices provided by the system. Furthermore, their understanding that the website was able to help them to master the module content shows that they were allowed to take responsibility for their own learning. These two concepts both provided autonomy support. Finally, the customisation system provided students with an opportunity to express themselves in a way that provided a deeper connection to their own personalities, this too was able to support feelings of autonomy.

5.2.1.3 Relatedness

Relatedness is the need to feel a sense of belonging and significance among others (section 2.1.1.1.3). The following section describes how the website was able to foster feelings of relatedness in small ways, albeit not as effectively as it fostered feelings of competence and autonomy.

The lecture awards (section 4.4.9) were intended to remind students that there was a community built around the website. When asked whether they felt that this was the case (section Appendix B, question 11) (without the mention of the lecture awards), one focus group participant did bring up the lecture rewards as a way in which he was made aware that there were other people interacting with the website. This was the only mention of the lecture awards in relation to relatedness. Another focus group participant mentioned the class achievements (website achievements which were awarded to every member of the class) as something which made them aware of the class community.

The same question elicited a different response from another focus group participant. Across both focus groups, the same story was told of one student using the challenge feature to challenge a number of his classmates. None them wanted to accept the challenge (reasons discussed in section 5.2.3) so he eventually tricked another student by accepting the challenge on his behalf while he was away from his computer. The response to the above-mentioned question then was how this event and the actions of this one student had created something of a class joke which everyone was privy to. The participants of focus group 2 discussed this as an example of a community created around the website.

Another way in which students were made aware of the actions of their classmates was through viewing each other's profiles. 11 (39%) of questionnaire respondents said that they did this either to compare themselves or to see the progress of their classmates (Appendix A, questions 45-46):

> *"I wanted to see how everyone else was progressing."*
>
> *"To check how much better I was doing than them."*

The remaining 17 respondents explained that they were either unaware of the feature (a search bar at the top of the website) or not curious about the activity of their classmates.

In addition to viewing the profiles of others, some questionnaire respondents noted that they updated their achievement icons, avatars and titles in order to show off to others:

> *"Because I wanted everyone to know I was the Slayer of Incompetent Minions, it was nice to be able to prove my skill."*
>
> *"It looked cool, and showed that I was participating."*
>
> *"Different avatars to show off."*

In summary, the need of relatedness was not met as effectively as the previous two needs. However, students mentioned instances of being aware of the actions of their classmates, the anecdote of the challenge feature is an example of this. Additionally, some students expressed a desire to show off their achievements and view the progress of others. This shows that the students did not feel isolated in their actions on the website, and at times, felt a part of a social group beyond themselves. Finally, there are no data to show that the need of relatedness was thwarted by the website. This is reassuring, as thwarting the need would harm intrinsic motivation.

5.2.1.4 Intrinsic motivation

The discussion of how the website addresses the three basic needs makes it possible to draw certain conclusions about the general effect of the system on the intrinsic motivation of the students.

5.2.1.4.1 Reasons for website interaction

Competence and autonomy are the two primary needs important for the facilitation of intrinsic motivation, with relatedness also being important in that it should not be thwarted (Ryan & Deci 2017:99). From this it follows that the gameful website was able to intrinsically motivate the

students in the module, more specifically, the students were intrinsically motivated to use the website. This means that because the website was able to satisfy the needs of the students, they continued to engage with it. A number of quotes from the questionnaire support this statement:

> *"I did it because it was actually fun."*
>
> *"Fun just to wander around the maze and explore."*
>
> *"It was so much fun to battle the different types of monsters and see if I had gotten some AP from treasure chests."*
>
> *"I did it to gain AP and to test if I could do the task."*
>
> *"Yes you really wanted to do the quests just because they are fun, we like playing games."*
>
> *"I like to fight monsters."*
>
> *"During the whole of the module. The website consisted of quizzes and tests in the form of a game, which made it fun to learn the languages. This mindset [sic] motivated me to work with the content of the course independently as I enjoyed it."*

In addition to the questionnaire data, observation data collected throughout the semester show a number of instances where the design of the website was cause of motivation for the students to continue using it. There was an instance where class attendance was low due to it being the day before the start of university holidays. One student in the class asked if everyone in the class could receive extra AP for attending class. In another class, the lecturer apologised for an error which had arisen while the students tried to upload a part of their project to the website. In response, a student asked for an AP reward for the whole class to make up for the inconvenience. When the lecturer consented, a number of students celebrated loudly. A similar situation arose when a video did not work during a lecture and the students again asked for AP for the inconvenience. Finally, a student asked whether they could receive AP for doing well in the exam at the end of the semester. Students were also given access to extra quizzes on the course content, the reward for which was extra AP. 19 students out of a total of 34 completed the first quiz, and 11 completed the second and third quizzes.

The fact that the design of the gameful elements of the website were centred on earning AP was the reason for the students' desire to be awarded AP as often as possible throughout the semester. This supports the statement that the website was intrinsically motivating to use. This is an interesting development to take note of because it shows how the students attached value to a

"currency" which had no value in the real world, but to them it was still important enough to bargain for and to put in effort for.

The website not only made it easier for the students to engage with the content of the module; it also had an impact on their motivation to do so as well as with the amount of effort that they were willing to invest into the module:

> *"…it was a way to motivate me to actually like get through the work…"*

> *"Motivated me and kept my interest in the subject."*

When asked during the focus group whether the website caused them to put more effort into the module (Appendix B, question 9), a participant responded with the following answer:

> *"I wouldn't call it necessarily effort because it's fun doing it. So it doesn't feel like, 'ah, I've got to do this now, I gotta [sic] do a quiz or-'. It was actually fun doing it; so to me, I don't know, it wasn't really effort."*

This answer is echoed in the questionnaire when the website was referred to as a "game" and the word "fun" was often used to describe the gameful elements:

> *"I did it because it was actually fun."*

> *"It's just exciting to be able to play games and work at the same time. It makes it a lot more enjoyable."*

> *"The website definitely increased my interest and involvement in the module because it turned work into a game."*

This is one of the defining characteristics of a gameful system (section 2.3.2.2) – that it presents the user with a variety of experiences, ranging from playful to gameful. The designer of the system does not intend for it to be a full game, but the users might experience it that way. What this also means is that in a general sense, the website has successfully been "made gameful". These responses mentioned above therefore provide evidence for the effect of the website on the attitude of the students, which in turn affects the amount of effort that they applied to the module:

> *"It really changes your attitude towards a subject by making you actually enjoy and look forward to working in that subject."*

This response, and the others before it, show that the gameful experience provided by the website allowed the respondent to feel positive towards the module and the course content. This in turn, had a positive effect on their learning experience.

This positive attitude towards the module was also evident in the students' comparison of the website to clickUP (a Blackboard learning management system used by lecturers at the University of Pretoria). This topic was raised during the focus groups. When asked how they felt about using the website (Appendix B, question 2), the participants had a tendency to compare it favourably to clickUP before describing their feelings concerning the gameful elements. This tendency to compare makes sense when one considers that clickUP is the main organisational website to which the students are exposed. It is natural for them to consider new organisational websites in light of what they have used before.

In general, the data showed that the students found the website more user-friendly, attractive and interesting to use compared to clickUP. More importantly, there are five instances where the questionnaire respondents describe how the gameful website decreased their anxiety or dread concerning their work compared to the opposite effects of clickUP:

> *"It made me feel more relaxed toward the work, which made it a lot more enjoyable."*

> *"It feels more like a game than work, which doesn't make me dread seeing my announcements."*

It is therefore not surprising that all but one of the questionnaire respondents said that they preferred using the gameful website to using clickUP (Appendix A, question 53).

5.2.1.4.2 Intrinsic integration

The effect of this intrinsic motivation towards the website hinges on the principle of intrinsic integration (section 0). This is the concept describing how the learning content is an inherent part of the system and in interacting with the system, the users are automatically interacting with the content. In the gameful website, the gameful elements of quests and monsters were built around the content to be taught. In addition, the entire system was driven through the acquisition of AP (section 4.2.1.1.2), which meant that in order to progress in any way, users had to collect AP which could only be done by interacting directly with the content. The result of intrinsic motivation to use the website and intrinsic integration is that students spent more time engaging with the content:

> *"It definitely made it more personal seeing as we have our own website that other modules don't, and it really tied in well with the content of our work."*

"The map was fun to use and it was a game-based way of refining the skills we learn within the module. The quests were directly related to the content of the course, which made it impossible not to use as a practice mechanism."

"To see the building of the website was really entertaining as it showed you all the steps and chapters that we have learnt that are used in building a website."

The quotations above show that the students understood the value of interacting with the website due to intrinsic integration. A positive benefit of this concept is the fact that students came to view the content as enjoyable:

"The interactive exploration as it felt like more of an adventure to learn than a chore."

5.2.1.4.3 Intrinsic motivation towards course content

There is also some evidence of the website positively affecting the intrinsic motivation of the students towards the content.

22 (79%) questionnaire respondents said that they were intrinsically motivated towards the content of the module at some point (Appendix A, questions 21-22). When asked on a scale of one to ten, where one corresponded to *"I was rarely intrinsically motivated"* and 10 corresponded to *"I was intrinsically motivated throughout the module"*, how often this was the case, these respondents replied with an average of 6,9. Reasons provided for a high value of 8, 9 or 10 were primarily centred on enjoying the course content and feeling competent regarding it. Of the suggestions provided by respondents to improve their intrinsic motivation in the module (Appendix A, question 23), 10 suggestions were positive feedback on how the website could be improved. For example:

"More monsters to fight! Bigger map for the game! More challenging questions in the game!"

This shows that some students considered the website a good way to facilitate intrinsic motivation.

Figure 69 shows that some students reported being intrinsically motivated towards the content by the website.

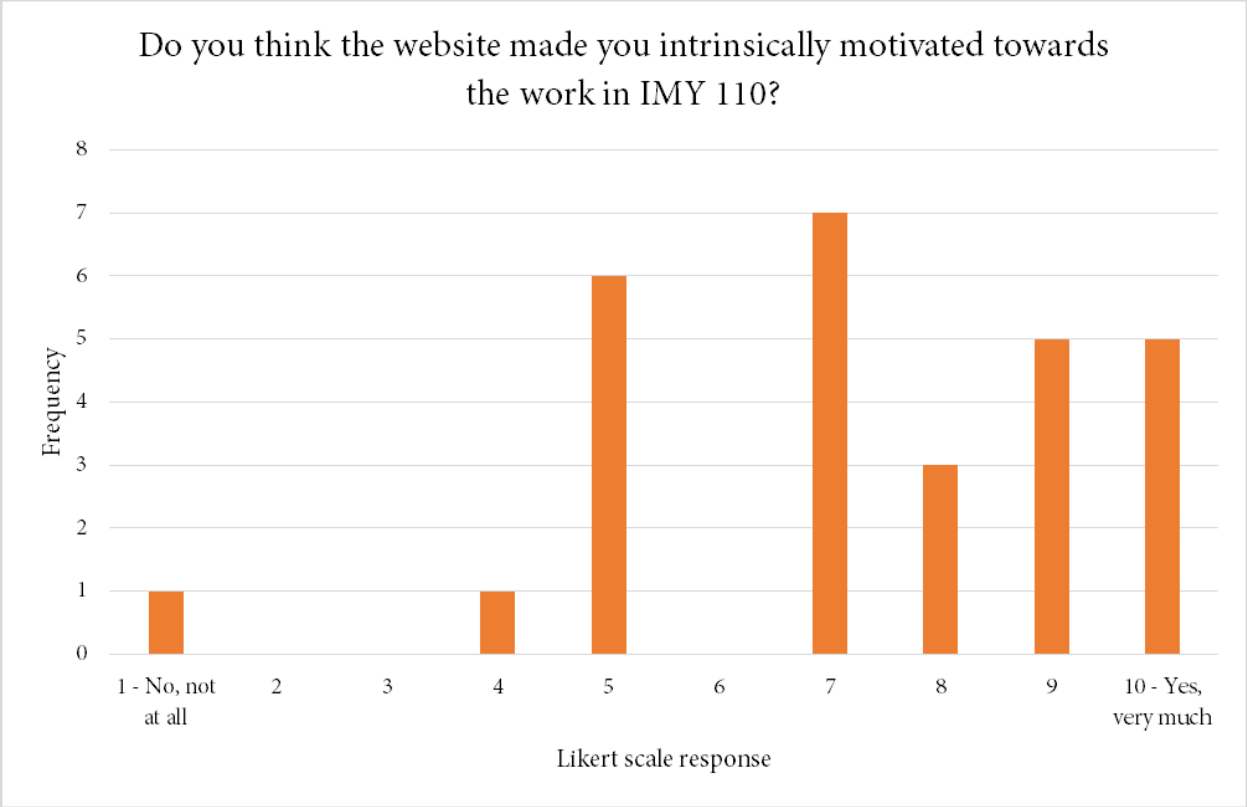

Figure 69 - Bar graph showing the opinions of the students about whether the website made them intrinsically motivated towards the course content (n = 28); source: questionnaire (Appendix A, question 61)

Some of the reasons provided for responses of nine or ten were:

> *"It really changes your attitude towards a subject by making you actually enjoy and look forward to working in that subject."*

> *"It made me more confident because it's the only thing I don't have to rush and it's helpful, fun, user friendly and it has a game."*

In addition, 16 (57%) of questionnaire respondents said that they were encouraged to spend additional time engaging with the content outside the module because of the website (Appendix A, question 59). Some reasons provided for spending this time included desires to learn more about the content or to challenge themselves by creating their own websites:

> *"I would do a lot of quests in my free time to relax or practice."*

> *"Sometimes when I did not know what to do I did some quests and fought some monsters."*

"I used it as a platform to engage in the content in my spare time and this motivated me more."

The remaining 12 (43%) respondents explained that they did not have enough free time to spend additional time on the course content or that they were already doing so, but that it was not because of the website. Specifically, the respondent who provided a value of one in Figure 69 said that:

"I already was spending my spare time learning new web design tricks."

The fact that free time spent on content is considered is based on the free-choice paradigm (Deci 1971), which is a measure of intrinsic motivation. Figure 63 (section 5.1.1.2) provides evidence for students spending time over a weekend using the website, and Figure 64 shows that some of this time was spent engaging with the optional, gameful elements.

Another student provided the following reason for spending additional time engaging with the content:

"To see if I can design a website also successful as the website."

This response is echoed 12 more times by other questionnaire respondents throughout the questionnaire:

"It constantly reminded me of what cool things can be done with CSS and HTML."

"I saw the potential of what could be."

"It's really cool to imagine that we will eventually learn to make really awesome websites like this one."

This group of responses shows how the website itself was an effective motivator to the students because the content being taught was concerned with web development concepts. This meant that the website piqued their interest by showing them how the languages could be used. This is a development that will be unique to this particular study due to the type of module in which the website was implemented.

5.2.1.4.4 Summary of intrinsic motivation

In summary, the satisfaction of the three basic needs meant that the website was intrinsically motivating to the students and this caused them to interact with it. Due to the principle of intrinsic integration, this means that the students spent more time engaging with the content of

the module. In addition, some students reported being intrinsically motivated towards the content.

Despite the intrinsically motivating effect of the website, it is not possible to say that all students were intrinsically motivated towards the *content* of the module because of the effects of the website. This is where it is important to discuss the principle of extrinsic motivation and the effect of the website on integration and internalisation.

5.2.1.5 Extrinsic motivation and integration

Extrinsic motivation and by extension, integration, are important concepts in cases where an activity is not inherently enjoyable and therefore not intrinsically motivated (section 2.1.1.2.2).

Section 3 of the questionnaire (Appendix A, question 7-8) was dedicated to determining the type and amount of motivation of the respondents towards the module. In an adapted version of the Academic Motivation Scale (Vallerand et al. 1992), it was possible to gauge the various reasons the students had for putting effort into the module.

Figure 70 shows the average of the ratings on a Likert scale of one to seven of various statements representing the different types of motivation (section 2.1.1.2.2.1).

Figure 71 shows the average of these values. The graphs show that the students had, on average, higher levels of the more internalised forms of extrinsic motivation (integrated and identified regulation) compared to the less desirable forms of extrinsic motivation. Externally regulated and introjection regulated behaviours are less desirable because they are not as likely to be sustained as the more internalised, autonomous forms of extrinsic motivation. Integrated and identified regulations exhibit more self-determined behaviour because they have a more internal PLOC.

It also evident that the students had some intrinsically-motivated reasons for engaging in the module, but these were not their only reasons.

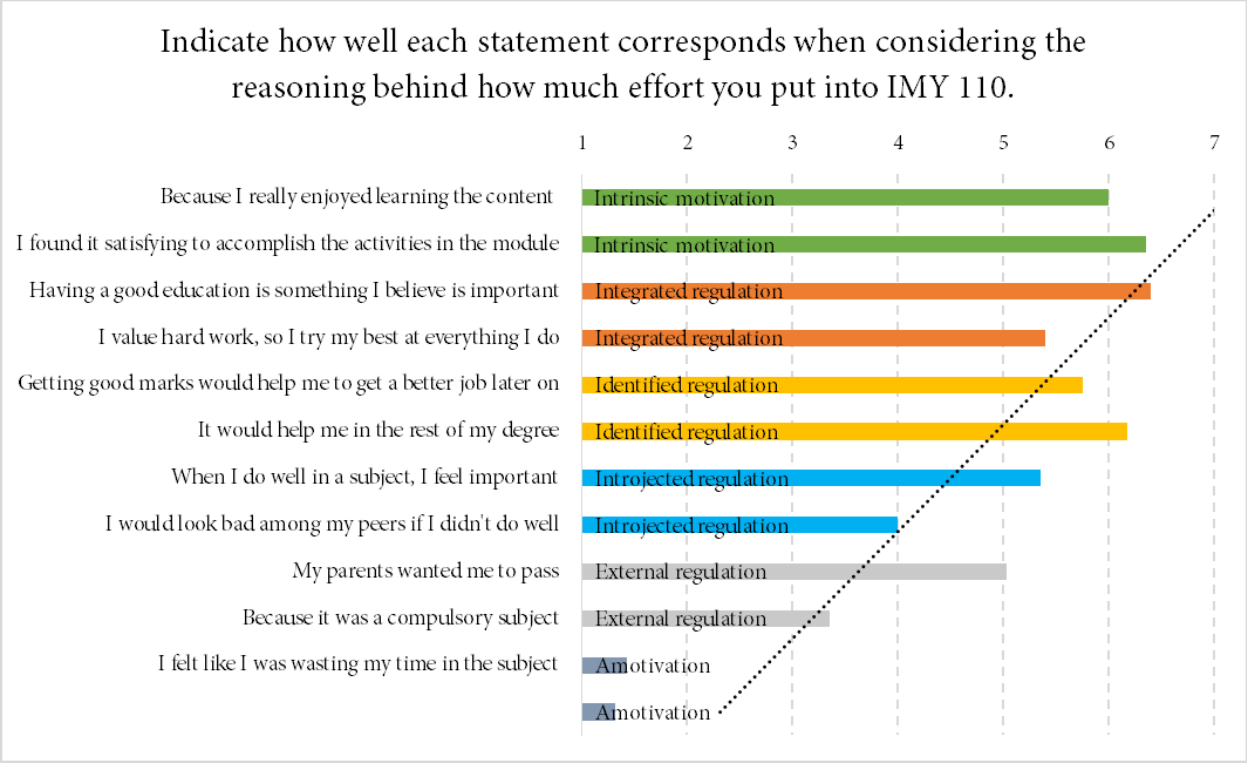

Figure 70 - Bar graph showing the reasons why students put effort into the module (n = 28); source: questionnaire (Appendix A, question 8)

The results supplied in Figure 70 and Figure 71 are supported by the data from the self-regulation questionnaire (Appendix A, question 9-11). Every questionnaire respondent exhibited an autonomous regulation style, and the average for autonomous regulation was higher than the average for controlled regulation by 2,09 (on a Likert scale of one to seven). This is called the relative autonomy index and the positive value indicates a tendency towards autonomous regulation.

From the data above, it is possible to see that the average student had a high level of internalisation. This is supported by the reported level of effort applied (an average of 7,4 out of 10) as well as the high level of perceived competence of the students (Appendix A, question 6). Perceived competence is a person's measure of their own competence in an activity. The results from question 6 show that on average, all the respondents had a high level of perceived competence – each item on the scale averaged a value of greater than 6 out of 7.

The high level of internalisation evidenced by the data above is also supported by the additional time spent using markup languages not for the purpose of passing the module (Appendix A, questions 18-19) (25 (89%) of the students reported doing so). Reasons provided for spending

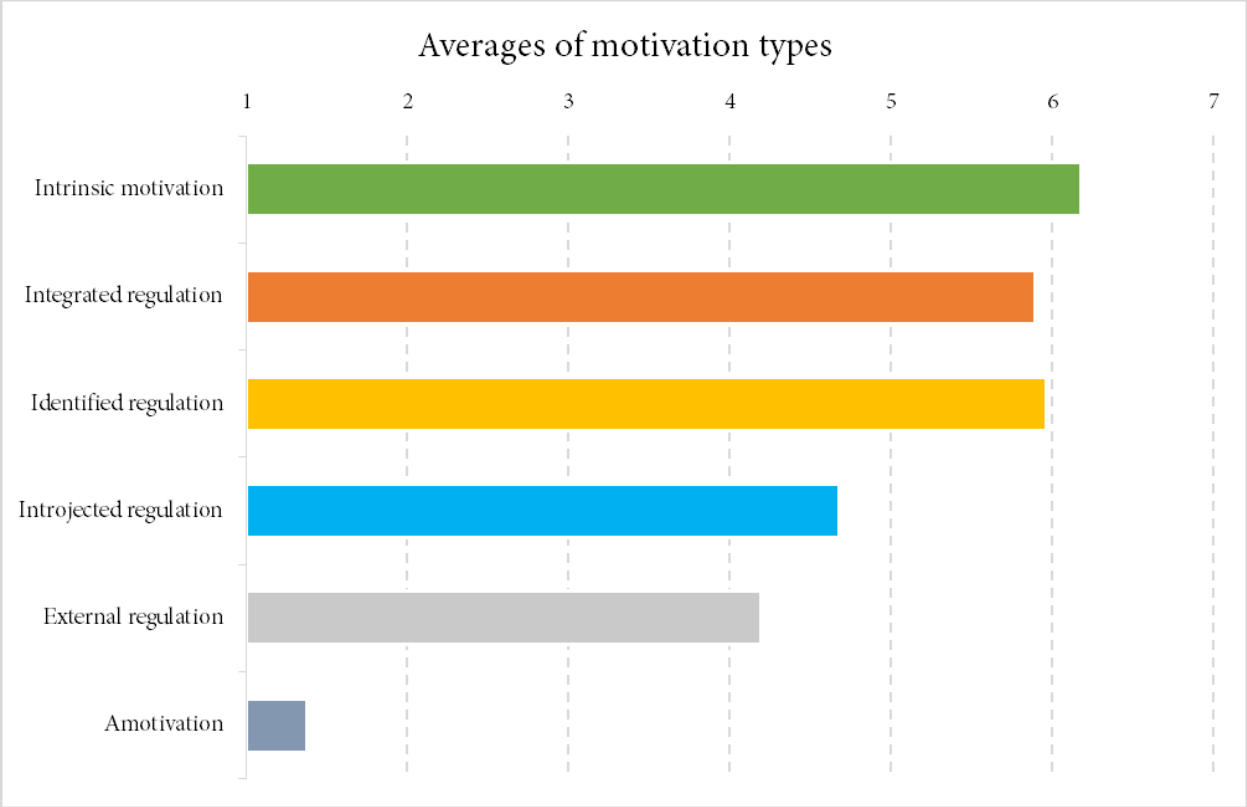

Figure 71 - Bar graph showing the average type of motivation behind the effort students invested into the module (n = 28); source: questionnaire (Appendix A, question 8)

more time indicate that the students enjoyed interacting with the languages or did so to improve their understanding:

> *"Would play around with the language for fun just to see all the different ways you can achieve something as well as do it as a pass time [sic] or hobby."*

> *"I wanted to test different things and gain a better understanding by watching YouTube videos and applying what I have learnt in them. It was fun for me to get cool things right and understand how they work."*

> *"I wanted to learn more about the language."*

The high level of effort applied, the high level of perceived competence and the additional time spent using the markup languages shows that that the students were intrinsically motivated towards the content at times, and at other times, had highly extrinsically-motivated reasons for engaging with it. The presence of extrinsic motivation proves the importance of fostering internalisation in order to allow the students to continue to reap the benefits of these

autonomous forms of motivation. This is done by meeting the three needs. Section 5.2.1.4 showed that the website was able to meet the three needs and that the effect was intrinsic motivation towards the website. It therefore follows that if the students approached the website whilst being extrinsically motivated towards the content, the fact that the website was able to meet the three needs would in turn facilitate increased internalisation.

5.2.2 Levels of engagement

The website was not used in equal amounts or in the same way by each student. Figure 72 indicates this by showing how each student spent a different average amount of the website on an average visit.

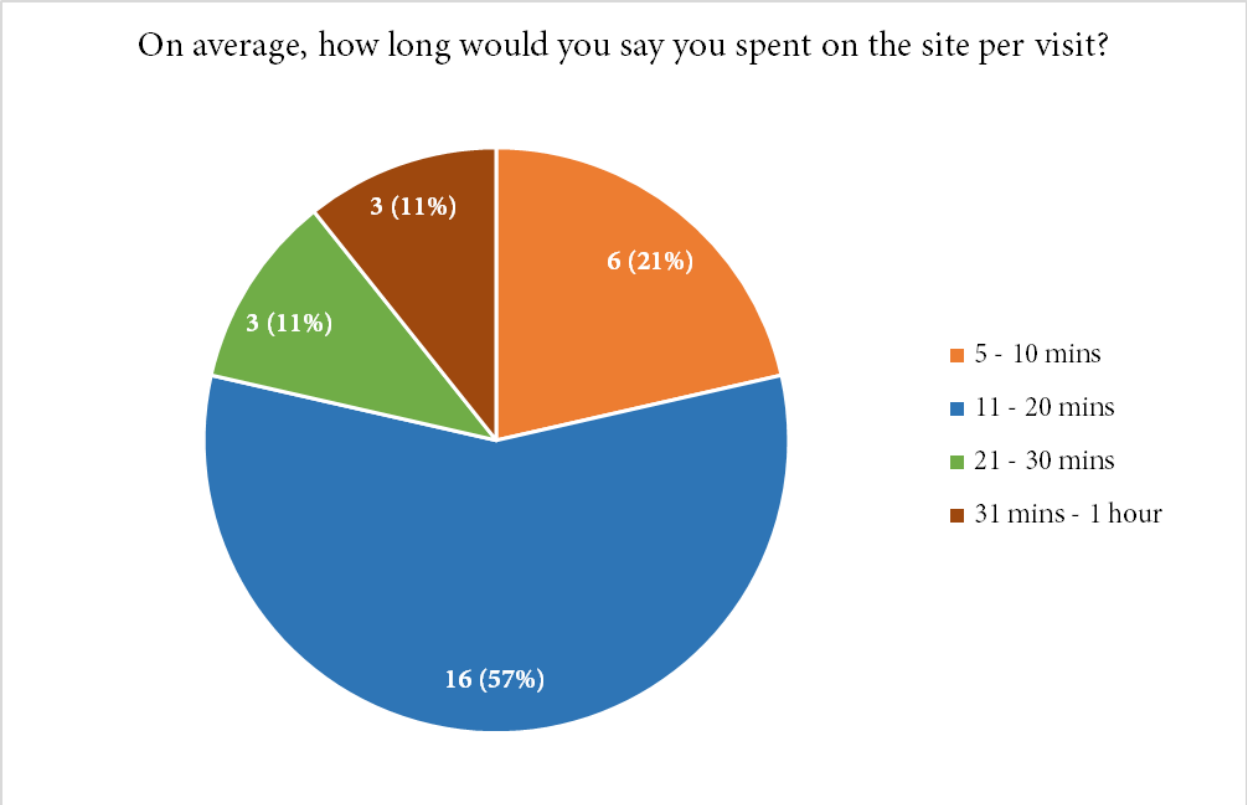

Figure 72 - Pie chart showing the users' average amount of time spent on the website per visit (n = 28); source: questionnaire (Appendix A, question 25)

In addition, the students interacted differently with the various elements on the website. Figure 73 shows how much the various elements of the website were used based on data from the questionnaire.

Additionally, responses to the questionnaire show that students experienced the gameful website in a number of different ways. The two excerpts below clearly show the contrast in the various students' approaches to the website:

> *"I didn't see a reason why I needed to play the game."*

> *"It's a unique method of practising which really helps when preparing and studying for tests and practicals."*

Both responses are similarly echoed throughout the survey when respondents were asked how they experienced the achievements awarded and whether they did quests or fought monsters. This shows that not all students engaged with the gameful parts of the websites, while others thoroughly enjoyed them.

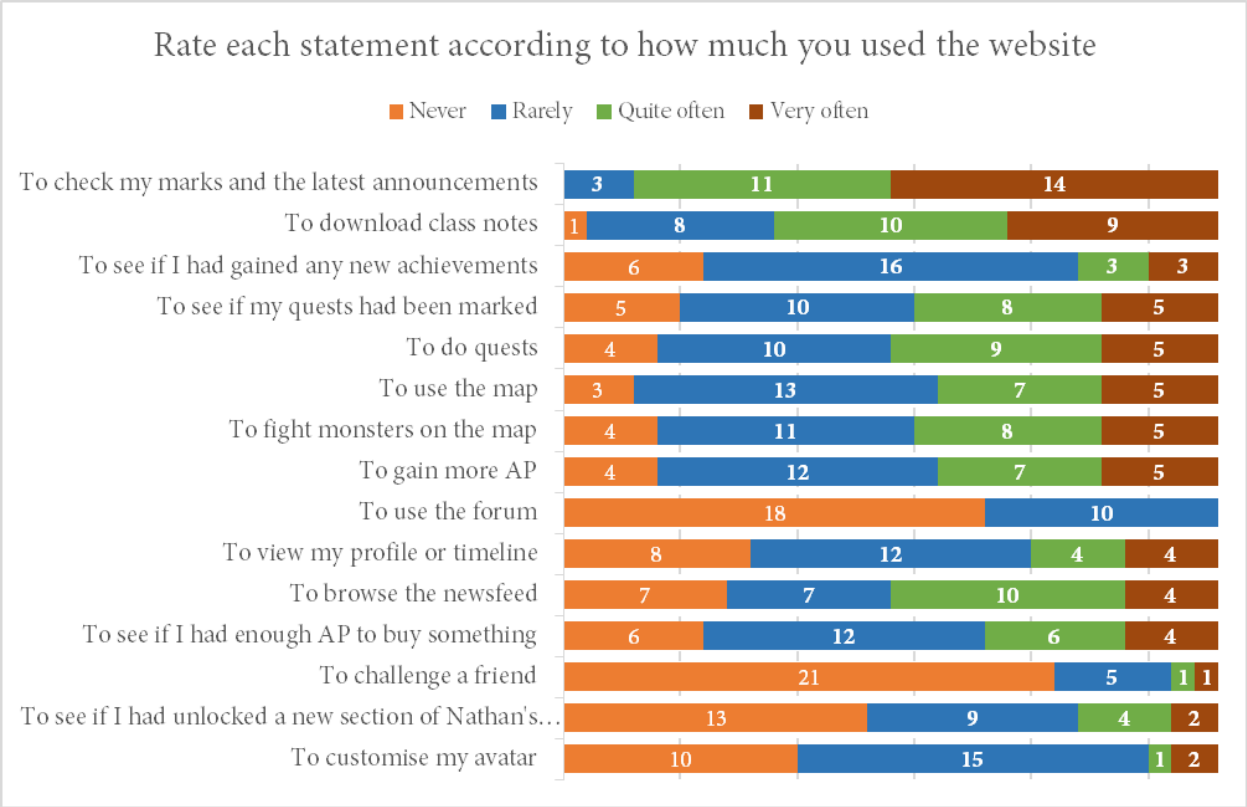

Figure 73 - Stacked bar graph showing how often students used the various parts of the website (n = 28); source: questionnaire (Appendix A, question 28)

This difference was also found among the focus group participants. Focus group 1 contained five participants who had interacted with the website greatly throughout the semester while focus group 2 contained four participants who had been less involved with the website. The

participants were divided into the groups based on their own assessment of their level of interaction which was then confirmed with data from the website (number of quests completed, number of AP collected, number of monsters fought etc.).

The general difference which could be noted between the two focus groups was that focus group 1 (students with higher interaction levels) provided more positive feedback towards the gameful sections of the website and spoke strongly of the aid of the website in their studies. Focus group 2, while still positive about the website and its effects, mentioned lack of time and interest as reasons why they participated less as the semester continued. In general, the effects of the gameful website elements seemed less pronounced on the members of this group and the conversation often drifted to a comparison between this website and those provided by other modules.

This observation was echoed by the questionnaire results. Positive feedback towards the gameful elements was provided by students who rated their interactions with the particular elements in question to be high.

Out of 28 questionnaire respondents, four stated that they did not engage with the optional gameful elements provided. The reason given for not doing so was a lack of free time. A possible reason for this is the difference among students in their view of their studies. Some students understood the value of the website in helping them with their studies, as indicated by this response:

> *"It's a unique method of practising which really helps when preparing and studying for tests and practicals."*

A student with this opinion would be willing to spend free time on the website because of the value that it provides. Other students preferred to engage with the course content in their own ways:

> *"I learn easily enough from the book and slides and be sure and not feel the need to test myself."*

This student did not find value in using the optional parts of the website to help them learn, and therefore they would be unwilling to spend free time using these parts.

5.2.3 Ineffective gameful elements

This section discusses three gameful elements which were not effective within the system as well as one problem which arose whilst the website was being used.

The first ineffective gameful element was the narrative and fictional website progress. Only two questionnaire respondents said that they interacted with this feature. Reasons provided by the rest of the respondents included a lack of time or interest and simply forgetting about the feature. Other respondents said that they were more interested in other parts of the website, such as doing the quest or exploring the map. A number of students reported forgetting about this feature. This shows that even though it was intended to be an overarching element which provided context to the activities on the website, it is clear that it needs to be highlighted more in future implementations of the website in order for it to have the intended effect.

Another gameful element which was not used was the challenge system. Only one student engaged with this section of the website. The other questionnaire respondents said that they did not care to engage with this feature or did not have time. Others mentioned being too intimidated by their classmates. This response describes the negative effects of performance-contingent rewards, where people feel pressured to meet a certain standard instead of feeling competent when meeting the said standard (Ryan & Deci 2017:133). The final set of responses was centred on students feeling that the idea of competition with others does not suit them or their personality. The challenge system was designed to require the consent of both parties before a challenge was fully initiated and visible to other users. It was therefore the assumption that only consenting students would interact with it. However, since no students really interacted with this feature, it can be assumed that no negative side-effects were experienced and that in avoiding it, the students did not experience the feature as having a functional significance of control as would be likely with performance-contingent rewards.

The shop was also not used very often, as described in section 5.1.1.2. When the questionnaire respondents were asked how often they updated their avatar or profile frame and why (Appendix A, question 41-42), seven respondents explained that this feature was not important to them. This can be expected as not all users will enjoy every gameful element in the same way. Six respondents explained that they used their AP on the map instead. This provides further evidence for the power of AP within the system as the users understood that it needed to be saved carefully. Five respondents explained that they ran out of AP. This is the final problem which needs to be discussed in this section.

A lack of AP was mentioned by a number of students as a barrier to their progress on the website. It was intended to be the driving force behind all activity on the website (section 4.2.1.1.2), and if a student had used all their AP through exploring the map, the expectation was that they would attempt quests (accessed through the quest page) in order to get more AP. In addition, there were additional class quizzes and class achievements which also provided AP. This means that it was never really possible for a person to completely run out of AP. This issue was discussed among the participants of focus group 1 (those who had a high level of interaction with the system) and they had not found it to be a problem due to constantly completing quests.

> *"But I mean, if you're moving, you're finding quests then you should be completing quests. I think I finished both maps and I got like a hundred and something AP still to buy stuff. So I don't think AP is a problem."*

From this discussion it became clear that the lack of AP was only a problem to those students who did not fully interact with the system. However, the AP system could use constant improvement to ensure that no student, despite low levels of interaction, is left without means of engaging with the website, as this would lower their motivation. Future implementations of the website should therefore include hints as to how to get more AP if a user starts to run low.

5.3 Summary of chapter 5

The gameful website implemented in the module of IMY 110 was intended to motivate the students to interact with the course content in a sustained way. For this reason, the website was designed to include only intrinsically motivating elements (section 4.1) as well as to allow these elements to be engaged with at the discretion of each user.

In order to improve the motivation of the students, the website was designed to satisfy the three basic needs, which has been shown to lead to improved intrinsic motivation (section 2.1.1.2.3.1) as well as improved internalisation and by extension, more autonomous forms of extrinsic motivation (section 2.1.1.2.2.2).

Competence was satisfied by allowing the students to test and improve their knowledge of the course content through the monster and quest elements (section 5.2.1.1.2). These elements provided the students with opportunities to practice and engage with the content. This made their experience of the content better, more enjoyable and more game-like (section 5.2.1.1.1). Students also felt more confident about their abilities because these elements gave them the opportunity to prepare for assessments (section 5.1.1.2) and gave rise to feelings of mastery by

allowing users to prove to themselves that they understood the content. In addition, the map and the achievements provided the users with feedback on their progress (section 5.2.1.1.2) and this further enhanced feelings of competence. Finally, users created their own goals concerning the map (section 5.2.1.1.3) which are examples of optimal challenges which satisfy competence when overcome.

Autonomy was satisfied by allowing all the gameful components to be optional which gave the users choice within the system. Users reported not feeling pressured to engage with these optional components (section 5.2.1.2). The creation of their own goals concerning the map is also evidence that the users had choice within the system. Finally, the customisation section allowed users to craft their own identity within the system, which further satisfied feelings of autonomy.

Relatedness was satisfied to a lesser degree than the other two needs. It was done by creating a sense of community around the website through the ability to view the profiles of other users, the lecture awards and the stories told by students about the website.

This satisfaction of the three needs led to the facilitation of intrinsic motivation towards the website. This meant that the users were intrinsically motivated to use the website. This is partly due to the power of AP within the system (section 5.2.1.4.1). Designing the website around intrinsic integration meant that if students were intrinsically motivated to use the website, they would be directly interacting with the course content. Some students reported being intrinsically motivated towards the module content and the data also showed that the optional elements were used during the students' free time (section 5.1.1.2).

The results from the questionnaire showed that all the students exhibited highly autonomous forms of extrinsic motivation towards the module and its content. The facilitation of the three needs by the website would further improve internalisation and thus ensure that this extrinsic motivation remained autonomous.

Finally, the data showed that not all the students engaged with the website in the same way or same amount (section 5.2.2). Some students used the gameful elements often, while others said that they did not have the time or reason to do so. However, in general it was found that those students who used the gameful parts of the website more often provided more positive feedback about these elements. This shows the effect of the gameful elements on the students who participated.

The following chapter concludes this dissertation by answering the research questions and discussing recommendations for future research.

6. Chapter 6 – Conclusion

This chapter concludes the dissertation by providing a summary of the study. This is followed by a discussion of the results of the study which are used to answer the research questions. Finally, the contributions of the study and recommendations for future work are discussed.

6.1 Summary of the study

This study focused on the development of a gameful design website which would facilitate intrinsic motivation in students on a tertiary education level. The following steps were followed in order to achieve this:

- The existing body of literature was reviewed in chapter 2 to gain a thorough understanding of the concepts of motivation, gameful design and education.
    - **Motivation:** the focus was on self-determination theory and its mini-theories of cognitive evaluation theory and organismic integration theory. This provided an understanding of the factors which affect intrinsic and extrinsic motivation as well as how to effectively meet the three basic needs.
    - **Gameful design:** the concepts of gamification and gameful design were discussed and it was determined that gameful design is a more holistic approach as it is more concerned with the ways in which games are able to meet the three basic needs.
    - **Education:** theories of education, particularly constructivism, were discussed and an analysis of existing tertiary education gamification implementations was provided. It was found that most of these implementations focus on gamification as opposed to gameful design.
- The review of the literature made it possible to construct a theoretical framework which guided the design of the gameful system.
- The methodology of the study was discussed in chapter 3.
- The gameful system design was guided by the Lens of Intrinsic Skill Atoms method presented by Deterding (2015). It was first implemented as a pilot study in the IMY 120 2016 module. This formed part of the final testing phase of the system. The results of the pilot study led to the decision to implement the final system in the module of IMY 110 instead. The design of both the pilot system and final system were discussed in chapter 4.

Summary of study continued from previous page:

- The final implementation of the website in IMY 110 2017 was investigated as a single, embedded case study. The website was used over one semester by first-year undergraduate students.
- The results of the use of the website were gathered in the form of website use data, focus groups, questionnaire and direct observation. The analysis of these results was discussed in chapter 5.

This chapter provides the summary and final analysis of the results of the study by answering the research questions provided in chapter 1. In doing so, it will be possible to determine the success of the study as well as its contribution to the existing body of literature.

6.2 Results of the study

This section presents the results of the study in two sections. First, the logic models presented in chapter 3, section 3.1.2.2.3.5 are discussed in terms of the results. Secondly, the research questions of the study are addressed.

6.2.1 The logic models of this study

A logic model is a visual representation of a program which shows both the planned actions and the expected results (section 3.1.2.2.3.2). The applicability of a logic model in this study was discussed in section 3.1.2.2.3.4. The reasons provided are summarised below:

- A logic model would provide detail as to why gameful design is able to facilitate intrinsic motivation. This is because it would show the causal mechanisms behind the results obtained from the study and in doing so, provide a good overview of the findings of the study.
- The empirical results could highlight weaknesses in the model which will provide evidence for future work.

Section 3.1.2.2.3.5 provides the three logic models developed for this study. Each is included below (originally presented in section 3.1.2.2.3.5) for easy reference and discussed in terms of the results of the study.

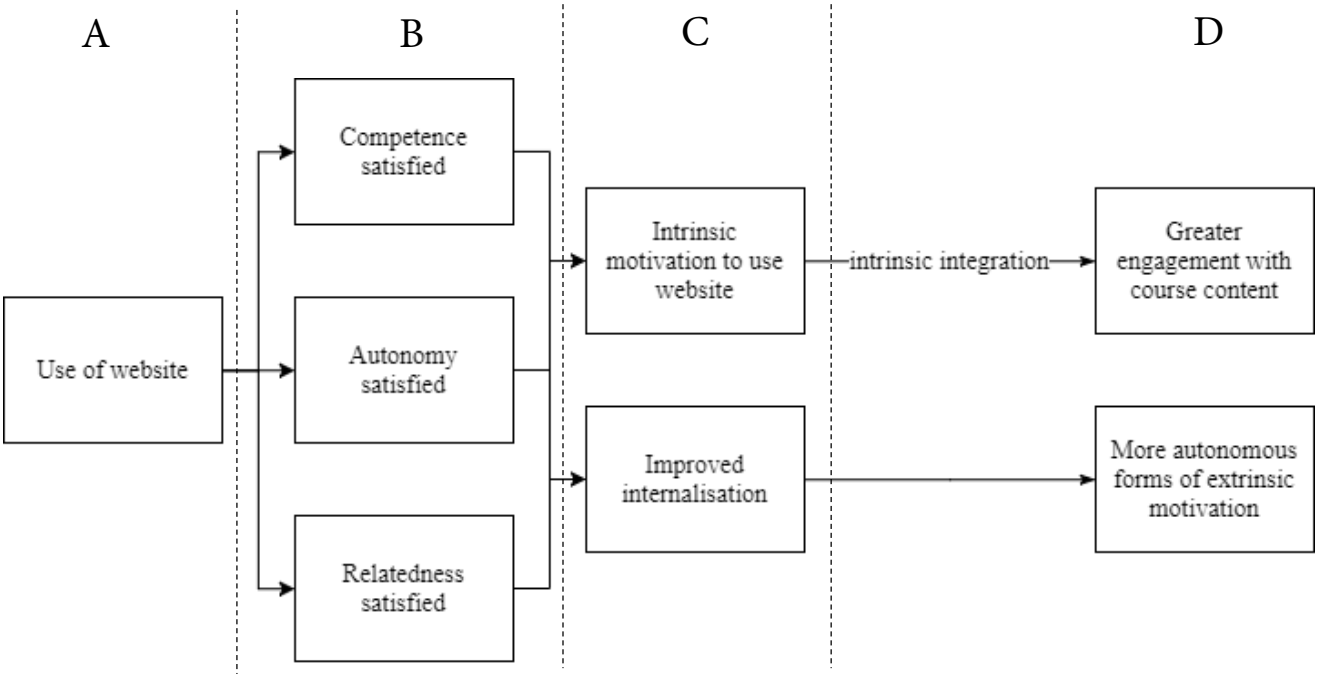

Figure 74 (= Figure 7) - The outcomes chain logic model for this study

Figure 74 (= Figure 7) shows the primary logic model for this study. It should be read from left to right, with the final intended impact of the gameful website shown in the rightmost blocks. In an outcomes chain logic model, each block is considered a result based on the input of the previous block.

Column B concerns the satisfaction of the three needs based on the use of the website. The data showing that these needs were satisfied are discussed in sections 5.2.1.1, 5.2.1.2 and 5.2.1.3 respectively. The results of satisfying the three needs are shown in column C. Firstly, the students were intrinsically motivated to use the website (section 5.2.1.4.1). Due to the concept of intrinsic integration being followed in the design of the website (section 5.2.1.4.2), intrinsic motivation to use the website meant that the students spent more time engaging with the course content than they would otherwise have done (the final result shown in column D). In addition to being intrinsically motivated to use the website, the data also showed that some students were intrinsically motivated towards the content (section 5.2.1.4.3). This is an added benefit of the gameful website.

The second block in column C shows that satisfaction of the three needs led to improved internalisation. This is inferred from the literature (section 2.1.1.2.2.2) and the result of this is that students who were extrinsically motivated towards the content would have improved, more autonomous forms of extrinsic motivation (section 2.1.1.2.2.1). This means that the behaviour is

more likely to be sustained. Section 5.2.1.5 showed that the average student exhibited a high level of internalisation towards the course content. The reason for the inclusion of extrinsic motivation in the logic model is because it is not possible to assume that every student will be intrinsically motivated towards the course content. The addition of the gameful elements in the website might still make them intrinsically motivated to use the website, but they would remain extrinsically motivated towards the module and its content. In this case, need satisfaction is still very important as it leads to improved internalisation, more autonomous forms of extrinsic motivation and ultimately, more sustained behaviour.

Situation	Context	Mechanism	Outcome
I	Students who use most of the gameful parts of the website	Gameful elements	Need satisfaction
II	Students who use a few of the gameful parts of the website	Gameful elements	Partial need satisfaction
III	Students who do not use the gameful parts of the website	Gameful elements have no effect	No need satisfaction

Table 16 (= Table 4) - A realist matrix logic model of the use of the website

Column A of Figure 74 (= Figure 7) represents the start of the logic model and it is concerned with the use of the website. Table 16 (= Table 4) addresses the results shown in section 5.2.2, which were that the website was not used in equal amounts by all students. These data also showed that students who used the gameful elements more often tended to provide more positive feedback about them. As a result, the realist matrix in Table 16 (= Table 4) deals with situations I, II and III in which the website was used in different amounts and the way in which this affected the need satisfaction of the users in each situation. In conclusion, it is clear that the users who engaged with the gameful parts of the website would have experienced higher need satisfaction and the rest of the effects described in Figure 74 (= Figure 7).

Finally, the narrative representation of the two logic models above summarises the findings in a cohesive manner (repeated from section 3.1.2.2.3.5):

The gameful design of the website works with students who engage with the optional gameful elements. Their interaction with these elements facilitates the satisfaction of autonomy, competence and relatedness which leads to the facilitation of intrinsic motivation. This is intrinsic motivation to use the website. Due to the concept of intrinsic integration, the facilitation of intrinsic motivation means that the students spent more time engaging directly with the course content. Additionally, the satisfaction of the three needs leads to increased internalisation and more autonomous forms of extrinsic motivation to learn the content.

6.2.2 Research questions

The findings of this study aim to answer the research questions provided in section 1.5. The primary research question of this study is:

How can gameful design be used to facilitate intrinsic motivation in tertiary education?

The following section will address each of the sub-questions before answering the primary question.

6.2.2.1 Research Sub-questions

The following sub-questions were used to aid the researcher in answering the primary research question of the study. They are answered either from the literature, the empirical data or a combination of the two.

6.2.2.1.1 Sub-question 1: Why is intrinsic motivation important in education?

This question was answered in the literature review in section 0.

Intrinsic motivation leads to high-quality learning, better conceptual understanding and the ability to use knowledge in a more flexible way. It also results in increased persistence and creativity. Finally, intrinsic motivation has been found to be an indicator for academic performance.

In summary, it is possible to see that intrinsic motivation has a powerful effect on learning and is therefore very important to attempt to facilitate in an educational context.

6.2.2.1.2 Sub-question 2: How can intrinsic motivation be facilitated?

This question was answered in the literature review in section 2.1.1.2.1.

Cognitive evaluation theory (CET) is a mini-theory of self-determination theory which describes the environmental factors that undermine or enhance intrinsic motivation. It is important to note that the principles of CET only apply to activities which hold intrinsic interest for the individual. Not all people are intrinsically motivated for every activity. Specifically, CET states that satisfying the needs of competence and autonomy, and relatedness to a lesser degree, will enhance intrinsic motivation.

Autonomy can be fostered through events that lead to an internal perceived locus of causality (CET proposition 1 – section 2.1.1.2.1.1). Controlling events such as task-, performance- and competitively-contingent rewards (section 2.1.1.2.1.1) will lead to an external perceived locus of causality and will harm autonomy. In addition, autonomy-supportive environments allow opportunities for choice and provide timely and positive feedback.

Competence, according to proposition 2 of CET (section 2.1.1.2.1.1), is affected by the type of feedback that a person receives from an external event. Positive feedback builds feelings of competence, while negative feedback or activities that are too difficult will damage competence. This means that a person should be presented with optimal challenges which include timely, informational feedback in order to bolster competence.

Finally, relatedness contributes to the facilitation of intrinsic motivation in that if it is thwarted it will negatively impact intrinsic motivation. Relatedness can be thwarted by failing to acknowledge or support a person within an environment and not providing them with opportunities to see their impact on others.

In summary, intrinsic motivation can be facilitated by satisfying the three basic psychological needs.

6.2.2.1.3 Sub-question 3: Why is gameful design able to facilitate intrinsic motivation?

This question was answered by both the literature and the empirical data of this study.

As answered by sub-question 2 above, intrinsic motivation can be facilitated through meeting the three basic psychological needs. Games are inherently good at satisfying these needs (section 2.1.3). They are able to satisfy competence by providing players with optimal challenges that adapt to their level of skill as well as clear goals to pursue. Autonomy is satisfied in games through customisation as well as allowing a player to choose which activities to do and which

strategy to employ to reach the required goal. Relatedness is satisfied through well-crafted characters that make a player feel relevant in the context of the game. Multiplayer games are also very good at satisfying relatedness through the teamwork that they require.

In addition to satisfying the three needs, games are described as autotelic objects (section 2.1.3.4) because playing the game is a reward in and of itself. This means that games are intrinsically motivating by nature.

Gameful design is described as the "end of affording *ludic* qualities or gamefulness in nongame contexts" (Deterding 2015:297). This means that if it is done properly, gameful design will enable a system to afford the same motivating qualities as games. This type of gameful design is facilitated through an understanding of the three needs as well as how games are able to satisfy them. Sub-question 4 addresses the specific way in which gameful design can be implemented to facilitate intrinsic motivation.

This answer from the literature is supported by evidence from the empirical data of the study. The gameful website designed for this study followed the principles of gameful design (section 0). It also focused entirely on intrinsic motivators in that all of the rewards provided on the system were intrinsic to the system itself. The primary example of this was the AP system in which AP only held value within the gameful website. The effectiveness of this element is described in section 5.2.1.4.1. The autotelic nature of games was also evidenced in the website through the responses of the students describing that the reason why they used the website was because it was enjoyable to do so (section 5.2.1.4.1.).

The system was primarily concerned with affording game-like qualities within the educational context of the IMY 110 module. This was done through satisfying the three basic needs (section 5.3) and as a result, students were intrinsically motivated to use the website (section 5.2.1.4).

In summary, gameful design is able to facilitate intrinsic motivation because it is concerned with affording the qualities of games within non-game systems. Games are very good at satisfying the three needs and motivating people. In addition, games are autotelic objects which makes them enjoyable and satisfying to engage with. It therefore follows that if gameful design is well-executed it will have the same effect.

6.2.2.1.4 Sub-question 4: How can an educational gameful system be designed to facilitate intrinsic motivation?

This sub-question was answered through the empirical data collected.

The gameful website was designed to follow the principles of gameful design (section 0) using the Lens of Intrinsic Skill Atoms method from Deterding (2015).

Firstly, formative research (described in section 3.2.2.2) made it possible to understand the types of users and their needs within the system (this is detailed in section 3.2.2). This meant that the system could be designed specifically to meet their needs.

Secondly, the system was designed for systemic emergence instead of following an inherent-additive approach of adding game elements to a context. This is the primary reason why the pilot study was used to determine the effectiveness of the various parts of the website. This meant that the system could be tested to ensure that each element elicited the motivating experience which it was designed to give rise to. This is the reason why a number of changes were made between the pilot system and final system (section 4.4).

The principle of intrinsic integration played a large role in the design of the system. It is specifically important in an educational gameful system to ensure that the tasks the users are doing are directly related to their learning goals. It involves turning the user's existing challenges within the system into motivating experiences. This was primarily done through the quest (section 4.2.1.1.4) and monster (section 4.2.1.1.3) elements in the system as these components allowed the users to interact directly with the content in a gameful way. In addition, the rewards within the system, such as AP (section 4.2.1.1.2) and achievements (section 4.2.2.1) were crafted in such a way so as to further encourage engagement with these elements.

Finally, the website was designed for basic need satisfaction. This is why a thorough understanding of motivation and games was required before designing the system. The needs of the users were satisfied in various ways. Firstly, autonomy was satisfied (section 5.2.1.2) by making the website optional as this provided users with the element of choice as to which elements they would like to engage with. The ability to customise their avatars as well as explore the map section without pressure also facilitated autonomy.

Competence was satisfied (section 5.2.1.1) through the challenges of monsters and quests which allowed users to test their knowledge and prepare for assessment. Coupled with informational feedback such as achievements and AP, these elements gave rise to feelings of mastery as users

could prove to themselves that they understood the content and were making progress in their own learning.

Relatedness was satisfied (section 5.2.1.3) by creating a sense of community around the website through allowing users to view each other's profiles and by using lecture times to award users for their achievements on the website.

The focus on satisfying the three needs and on designing for systemic emergence through the use of a pilot study is what differentiates this gameful system from existing gamification systems which have used the inherent, additive approach.

It was also important to ensure that the website remained intrinsically motivating and did not give students extrinsic rewards as this would shift their perceived locus of causality to become external and would negatively affect their intrinsic motivation. This was done by ensuring that all rewards provided by the website were intrinsic to the system. For example: AP had no real-world value which meant that any actions that students took to earn AP was because they were intrinsically motivated to use the website.

The logic model provided in Figure 74 (= Figure 7) (section 6.2.1) shows a summary of the success of the website by providing an overview of the causal mechanisms behind the gameful design.

In summary, to answer the question of how an educational gameful design system can be designed to improve intrinsic motivation, the following set of guidelines is provided:

Follow the requirements for gameful design (which can also be followed by implementing the method by Deterding (2015)) by:

- Conducting formative research to understand the needs of the users.
- Designing of systemic emergence through iterative prototyping and testing until the desired experience is achieved.
- Design around intrinsic integration by converting the user's inherent challenges in the system into motivating experiences.
- Aim to satisfy each of the three basic needs.
- Avoid using extrinsic motivators such as real-world rewards.

6.2.2.2 Primary research question

Having answered each of the sub-questions, it is now possible to answer the primary research question. This question is:

How can gameful design be used to facilitate intrinsic motivation in tertiary education?

The first part of this question, that of how such a system can be designed, is discussed in chapter 4. This chapter provides the detail on how the gameful website was designed and which design decisions were made to ensure that the three basic needs would be met. The remainder of the primary question requires showing that the website described was indeed successful at facilitating intrinsic motivation in a tertiary education context.

Sub-question 1 (section 6.2.2.1.1) established the importance of intrinsic motivation in an educational context. It showed that intrinsic motivation leads to high-quality, sustained learning.

Sub-question 2 (section 6.2.2.1.2) discussed the way in which intrinsic motivation can be facilitated by describing that the needs of autonomy, competence and relatedness should be met. Sub-question 3 (section 6.2.2.1.3) confirmed that gameful design is an effective method to use to do this. This is because good gameful design can cause a system to afford the same motivating experiences as good games and games are inherently good at satisfying the three needs.

Finally, sub-question 4 (section 6.2.2.1.4) discussed the specific way in which an educational gameful system can be designed to facilitate intrinsic motivation by discussing the design of the gameful system designed for this study.

By answering these sub-questions it can be seen that the gameful website designed for this study was able to facilitate intrinsic motivation in the users within a tertiary education context.

6.3 Recommendations for educators

The following list of guidelines has been developed from the findings of this study and can be used by other educators who wish to design their own gameful educational systems.

- Base the design of the system on the requirements for gameful design (described by Deterding (2015:305)) (These guidelines were applied to the design of the gameful system for this study).
    - Designing for systemic emergence is incredibly important as this is what distinguishes gameful design from gamification. It will ensure that the desired motivating experiences are afforded by the system. If possible, test the implementation through a pilot study as part of the process of iterative testing.
    - Intrinsic integration is a key component of gameful education systems. The learning goal of the user must also be the primary challenge of the system.
    - Design for need satisfaction as this is what leads to intrinsic motivation. See Table 17 for a summary of the successful gameful elements used in this study and the needs they satisfied.
- When designing for intrinsic motivation, all rewards given by the system must remain intrinsic to the system. If an external reward such as a deadline extension or extra credit is given, then the motivation of the system will become extrinsic.
    - It is therefore helpful to add an element of currency to the system (as AP was in this study) in order to attach value to the actions within the system (see section 4.2.1.1.2).
    - In order to add additional value to the currency within the system, it is helpful to extend the rewards beyond the system. This means including elements such as lecture achievements or optional quizzes on course content that result in system currency rewards (see section 4.4.9).
- Ensure that the system reminds the users about the optional content so that they do not forget that it is available.
- Be aware that participation with the system may decrease after the initial excitement wears off (section 5.1.1.2). It would therefore be helpful to find a way to change/adapt the gameful elements as the users engage with the system so that they remain interested.

User need	**Successful gameful website elements used in this study**	**Goal of gameful element**
Autonomy	Map (section 4.2.1.1 and section 4.4.2)	Opportunities to explore. User has opportunity to make their own choices. Add value to the currency of the system. Visualisation of progress. Small rewards.
	Choice of monsters and quests (section 4.2.1.1.3, 4.2.1.1.4, 0, 4.4.4)	Make the gameful elements optional.
	Customisation of avatar (section 4.2.2 and section 4.4.6)	User can craft their own identity. User has opportunity to make their own choices. Add value to the currency of the system.
Competence	Quests and monsters	Optimal challenges. Informational feedback. Intrinsic integration. Feelings of mastery from successfully overcoming the challenges.
	Achievements and titles (section 4.2.2)	Informational feedback. Visualisation of progress.
	Class achievements (section 4.4.9)	Informational feedback. Visualisation of progress.
Relatedness	Class achievements	Build a community around the system.

Table 17 - The successful gameful elements used in this study and the reason for their use

6.4 Contributions of this study

The review of existing tertiary education systems which include gamification or gameful design concepts (section 0) showed that the majority of implementations focus on adding a few simple game elements to a system. The results from these studies, while mostly positive, cannot be expected to elicit long-term engagement from the users as these implementations are not truly affording the motivating experiences of games.

The first contribution of this study is therefore a tertiary education system which has successfully implemented gameful design and facilitated intrinsic motivation. This approach to "gamifying" education is rare and can therefore be considered a valuable contribution. This leads to the second contribution of this study – a list of guidelines for educators who also wish to apply gameful design to their courses. This list is provided in section 6.3

6.5 Recommendations for future research

This section discusses a number of areas which would benefit from additional research as a result of this study.

6.5.1 Keeping users engaged as they continue to use the system

The results of this study showed that user engagement with the gameful elements of the website decreased as the semester continued (section 5.1.1.2). This could be due to the increased workload of the students, as well as a lack of continued interest in the gameful system. The studies covered in section 0 do not provide a solution to this problem.

As a result, additional research should be conducted into what can be done practically to keep users engaged with the system. This could potentially involve adapting the gameful elements as time progresses, or spending more time on developing an engaging narrative.

6.5.2 Facilitating relatedness effectively

The results in section 5.2.1.3 showed that relatedness was not satisfied as effectively as autonomy and competence. It is also challenging to allow users to interact with each other without introducing the element of competition or comparison, which has negative effects (section 2.1.1.2.1.1). For this reason, it is necessary to design innovative, social gameful interactions that foster relatedness without the downside of forcing users to be in competition with one another.

This might be successfully done by crafting challenges which require users to collaborate in order to complete them and thus share the rewards. It might also be possible to implement a system where users are able to help each other by suggesting solutions to problems posed by their classmates. These two aspects require further research as well as user testing.

6.5.3 Improving the unsuccessful elements

Section 5.2.3 discussed the gameful elements which did not have the intended effect that they were designed for. These elements were the narrative and the challenge section. The results showed that students forgot about the narrative or were not interested in pursuing it. With regards to the challenge system, users said that they did not enjoy being in competition with each other or that they felt too intimidated to challenge other students. Additional research should be directed towards improving these elements and implementing them again to determine whether the changes were successful.

In terms of the narrative, it is firstly important to remind users of the components relating to the narrative as the results showed (section 5.2.3) that they tended to forget about them. In addition, the narrative should be rich and engaging, and it should be intertwined with all gameful elements. In this way, the user could be awarded parts of the story for engaging with various components. If it is well-crafted, the narrative could become a reward in itself. This does require a significant amount of time and effort which is potentially the reason why existing educational systems do not often use this gameful component.

With regards to the challenge system, it could be modified to allow users to challenge themselves. This means that they could attempt to improve on their own previous performance instead of competing with their classmates. For those users who do enjoy competing with their classmates, the system could be modified to be made more exciting through graphics and interesting feedback. It could also potentially expanded to allow real-time challenging where both parties are actively completing the activity at the same time. This would cause users to be more engaged with the element, rather than waiting for their component to complete the task.

All these improvements require further research, implementation and user testing.

6.5.4 Understanding why students did not engage with the gameful elements

The results of the study showed that not all users engaged with the optional, gameful elements (section 5.2.1.1.1 and 5.2.1.2). Often, a lack of time or interest was cited as the reason for this. It

would be helpful to future designers of gameful systems to understand why these users did not find the gameful elements as attractive as their peers, as well as what could be done to improve these elements in order to attract the attention of these users. This would most likely require additional interviews with these users as well as additional user testing.

6.5.5 Potential of a longitudinal study

The development of the gameful website to fit the content of the IMY 110 module makes it possible to continue using this website in future years with new users. In addition, using the data of this study, it would be beneficial to modify the website accordingly so as to improve it and to continue doing this with each successive set of data. This would result in a longitudinal study which may provide additional insight into the effectiveness of the gameful elements, as well as more specific data on how users engage with these elements.

6.6 Summary of chapter 6

This chapter concludes the dissertation. This study developed and implemented a gameful intervention in a tertiary education context in order to facilitate intrinsic motivation.

The findings indicate that the intervention was successful in intrinsically motivating the students to use the website and engage with the gameful elements. This in turn led to greater engagement with the course content.

This chapter has summarised the findings of the study and provided answers to the research questions. It has also discussed the contribution that this study makes to the existing body of literature as well as ideas for future research.

References

Abt, C.C. 1970. *Serious games*. New York: Viking Press.

Adams, E. 2013. *Fundamentals of Game Design*. Berkeley: New Riders.

Adams, E. & Dormans, J. 2012. *Game Mechanics: Advanced Game Design*. Berkeley: New Riders.

Aelterman, N., Vansteenkiste, M. & Haerens, L. 2018. Correlates of students' internalization and defiance of classroom rules: A self-determination theory perspective. *British Journal of Educational Psychology* 88(1):1–19.

Aguilar, S., Fishman, B. & Holman, C. 2013. Leveling-up: Evolving game-inspired university course design. In C. Martin, A. Ochsner, & K. Squire, eds. *Games+ learning+ society conference*. GLS. Madison: ETC Press:46–52. [Online] Available at: https://www.gradecraft.com/research/Leveling-Up.pdf [Accessed 5 July 2017].

Aguilar, S.J., Holman, C. & Fishman, B.J. 2015. Game-Inspired Design: Empirical Evidence in Support of Gameful Learning Environments. *Games and Culture* 13(1):44–70.

AlMarshedi, A., Vieira, V.W. & Ranchhod, A. 2015. SGI: A Framework for Increasing the Sustainability of Gamification Impact. *International Journal for Infonomics* 8(1/2):1044–1052.

Ames, C. 1992. Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology.* 84(3):261–271.

Aparicio, A.F., Vela, F.L.G., Sánchez, J.L.G. & Montes, J.L.I. 2012. Analysis and Application of Gamification. In F. Botella, ed. *Proceedings of the 13th International Conference on Interaccion Persona-Ordenador*. INTERACCION '12. Elche: ACM:1–2. [Online] Available at: https://dl.acm.org/citation.cfm?id=2379653 [Accessed 10 September 2015].

Arrasvuori, J., Boberg, M., Holopainen, J., Korhonen, H., Lucero, A. & Montola, M. 2011. Applying the PLEX framework in designing for playfulness. In A. Deserti, ed. *Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces*. DPPI '11. Milano: ACM:1–8. [Online] Available at: https://dl.acm.org/citation.cfm?id=2347531 [Accessed 11 May 2017].

Avedon, E.M. & Sutton-Smith, B. 1971. *The study of games*. New York: J. Wiley.

Bajko, R., Hodson, J., Seaborn, K., Livingstone, P. & Fels, D. 2016. Edugamifying Media Studies: Student Engagement, Enjoyment, and Interest in Two Multimedia and Social Media Undergraduate Classrooms. *Information Systems Education Journal.* 14(6):55–72.

Banfield, J. & Wilkerson, B. 2014. Increasing Student Intrinsic Motivation And Self-Efficacy Through Gamification Pedagogy. *Contemporary Issues in Education Research (CIER).* 7(4):291–298.

Barata, G., Gama, S., Fonseca, M.J. & Gonçalves, D. 2013. Improving Student Creativity with Gamification and Virtual Worlds. In L. E. Nacke, ed. *Proceedings of the First International Conference on Gameful Design, Research, and Applications*. Gamification '13. Toronto: ACM:95–98. [Online] Available at: https://dl.acm.org/citation.cfm?id=2583023 [Accessed 23 July 2015].

Barata, G., Gama, S., Jorge, J. & Gonçalves, D. 2013a. Engaging Engineering Students with Gamification. In C. Gatzidis & J. Zhang, eds. *2013 5th International Conference on Games and Virtual Worlds for Serious Applications*. VS-GAMES. Poole: IEEE:1–8. [Online] Available at: https://ieeexplore.ieee.org/abstract/document/6624228/ [Accessed 29 February 2016].

Barata, G., Gama, S., Jorge, J. & Gonçalves, D. 2013b. Improving Participation and Learning with Gamification. In L. E. Nacke, ed. *Proceedings of the First International Conference on Gameful Design, Research, and Applications*. Gamification 13. Toronto: ACM:10–17. [Online] Available at: http://dl.acm.org/citation.cfm?id=2583010 [Accessed 23 July 2015].

Bassil, Y. 2012. A simulation model for the waterfall software development life cycle. *International Journal of Engineering & Technology.* 2(5):2049–3444.

Baxter, G. & Sommerville, I. 2011. Socio-technical systems: From design methods to systems engineering. *Interacting with computers.* 23(1):4–17.

Baxter, P. & Jack, S. 2008. Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report.* 13(4):544–559.

Belman, J. & Flanagan, M. 2010. Exploring the Creative Potential of Values Conscious Game Design: Students' Experiences with the VAP Curriculum. *Eludamos. Journal for Computer Game Culture.* 4(1):57–67.

Benington, H. 1983. Production of large computer programs. *Annals of the History of Computing.* 5(4):350–361.

Benita, M., Roth, G. & Deci, E.L. 2014. When are mastery goals more adaptive? It depends on experiences of autonomy support and autonomy. *Journal of Educational Psychology.* 106(1):258–267.

Benware, C.A. & Deci, E.L. 1984. Quality of learning with an active versus passive motivational set. *American Educational Research Journal* 21(4):755–765.

Björk, S. & Holopainen, J. 2006. Games and design patterns. In K. Salen & E. Zimmerman, eds. *The Game Design Reader: A Rules of Play Anthology*. Cambridge: MIT Press:410–437.

Blythe, M., Hassenzahl, M. & Wright, P. 2004. More Funology: Introduction. *interactions*. 11(5):36–37.

Bogost, I. 2015. Why Gamification is Bullshit. In S. P. Walz & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:65–79.

Bouça, M. 2012. Mobile communication, gamification and ludification. In A. Lugmayr, ed. *Proceeding of the 16th International Academic MindTrek Conference*. Academic MindTrek '12. Tampere: ACM:295–301. [Online] Available at: https://dl.acm.org/citation.cfm?id=2393132 [Accessed 11 May 2017].

Boyle, E.A., Connolly, T.M., Hainey, T. & Boyle, J.M. 2012. Engagement in digital entertainment games: A systematic review. *Computers in Human Behavior*. 28(3):771–780.

Bransford, J., Brown, A., Cocking, R., Donovan, S. & Pellegrino, J. 2000. *How People Learn: Brain, Mind, Experience, and School: Expanded Edition*. Washington: National Academy Press.

Brathwaite, B. & Schreiber, I. 2009. *Challenges for game designers*. Boston: Charles River Media.

Breuer, J. & Bente, G. 2010. Why so serious? On the relation of serious games and learning. *Journal for Computer Game Culture* 4:7–24.

Bruckman, A. 1999. Can educational be fun? In *Game Developers Conference*. GDC. San Jose: The Conference:75–79. [Online] Available at: http://www.cc.gatech.edu/~asb/papers/bruckman-gdc99.pdf [Accessed 19 June 2017].

Caillois, R. 1961. *Man, Play, and Games*. New York: The Free Press of Glencoe, Inc.

Calvillo-Gámez, E.H., Cairns, P. & Cox, A.L. 2009. Assessing the core elements of the gaming experience. In R. Bernhaupt, ed. *Game User Experience Evaluation*. Human-Computer Interaction Serie. London: Springer:47–71. [Online] Available at: http://link.springer.com/10.1007/978-1-84882-963-3_4 [Accessed 12 May 2016].

Carroll, J.M. 1982. The Adventure of Getting to Know a Computer. *Computer* 15(11):49–58.

Carroll, J.M. & Thomas, J.C. 1982. Metaphor and the cognitive representation of computing systems. *IEEE Transactions on Systems, Man, and Cybernetics* 12(2):107–116.

Chao, D. 2001. Doom as an interface for process management. In M. Tremaine, ed. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '01. Seattle: ACM:152–157. [Online] Available at: http://dl.acm.org/citation.cfm?id=365078 [Accessed 25 April 2016].

Chao, D. 2004. Computer Games as Interfaces. *interactions*. 11(5):71–72.

Chen, H. 1990. *Theory-Driven Evaluations*. Newbury Park: SAGE Publications, Inc.

Chen, H. 2015. *Practical Program Evaluation: Theory-Driven Evaluation and the Integrated Evaluation Perspective*. 2nd ed. Los Angeles: SAGE Publications, Inc.

Cheong, C., Cheong, F. & Filippou, J. 2013. Quick Quiz: A Gamified Approach for Enhancing Learning. In J.-N. Lee, J.-Y. Mao, & J. Thong, eds. *PACIS 2013 Proceedings*. Pacific Asia Conference on Information Systems. Jeju Island: AIS Electronic Library. [Online] Available at: http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1206&context=pacis2013 [Accessed 28 September 2016].

Chou, Y.-K. 2015. *Actionable Gamification: Beyond Points, Badges, and Leaderboards*. Online: CreateSpace Independent Publishing Platform.

Cook, D. 2007. The Chemistry Of Game Design. *Gamasutra*. [Online] Available at: http://www.gamasutra.com/view/feature/129948/the_chemistry_of_game_design.php [Accessed 18 February 2016].

Corbin, J.M. & Strauss, A.L. 2008. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. 3rd ed. Los Angeles: SAGE Publications, Inc.

Costikyan, G. 2005. I have no words & I must design. In K. Salen & E. Zimmerman, eds. *The Game Design Reader: A Rules of Play Anthology*. Cambridge: MIT Press:192–212.

Crawford, C. 1984. *The art of computer game design*. Berkeley: Osborne Media.

Crumlish, C. & Malone, E. 2015. *Designing Social Interfaces: Principles, Patterns, and Practices for Improving the User Experience*. Sebastopol: O'Reilly Media, Inc.

Csikszentmihalyi, M. 1990. *Flow: The Psychology of Optimal Experience*. 1st ed. New York: Harper & Row.

Darnon, C., Dompnier, B., Delmas, F., Pulfrey, C. & Butera, F. 2009. Achievement goal promotion at university: social desirability and social utility of mastery and performance goals. *Journal of personality and social psychology*. 96(1):119–134.

De Charms, R. 1968. *Personal causation : the internal affective determinants of behavior*. New York: Academic Press.

De Charms, R. & Shea, D.J. 1976. *Enhancing Motivation: Change in the Classroom*. Oxford: Irvington Publishers.

de-Marcos, L., Domínguez, A., Saenz-de-Navarrete, J. & Pagés, C. 2014. An empirical study comparing gamification and social networking on e-learning. *Computers & Education*. 75:82–91.

de Santana, S.J., Souza, H.A., Florentin, V.A.F., Paiva, R., Bittencourt, I.I. & Isotani, S. 2016. A Quantitative Analysis of the Most Relevant Gamification Elements in an Online Learning Environment. In J. Bourdeau, ed. *Proceedings of the 25th International Conference Companion on World Wide Web*. WWW '16 Companion. WWW '16 Companion. Montréal: International World Wide Web Conferences Steering Committee:911–916. [Online] Available at: http://dl.acm.org/citation.cfm?id=2891074 [Accessed 6 October 2016].

Deci, E.L. 1971. Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*. 18(1):105–115.

Deci, E.L., Connell, J.P. & Ryan, R.M. 1989. Self-determination in a work organization. *Journal of Applied Psychology*. 74(4):580–590.

Deci, E.L., Koestner, R. & Ryan, R.M. 2001. Extrinsic Rewards and Intrinsic Motivation in Education: Reconsidered Once Again. *Review of Educational Research*. 71(1):1–27.

Deci, E.L. & Ryan, R.M. 1985a. *Intrinsic Motivation and Self-Determination in Human Behavior*. New York: Plenum Press.

Deci, E.L. & Ryan, R.M. 1985b. The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality*. 19(2):109–134.

Deci, E.L. & Ryan, R.M. 1987. The support of autonomy and the control of behavior. *Journal of Personality and Social Psychology*. 53(6):1024–1037.

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.

Deci, E.L. & Ryan, R.M. 2002. Overview of self-determination theory: An organismic dialectical perspective. In E. L. Deci & Richard M. Ryan, eds. *Handbook of Self-Determination Research*. Rochester: University of Rochester Press:3–33.

Deci, E.L. & Ryan, R.M. 2008. Self-determination theory: A macrotheory of human motivation, development, and health. *Canadian Psychology/Psychologie canadienne.* 49(3):182–185.

Deci, E.L. & Ryan, R.M. 2014. Autonomy and Need Satisfaction in Close Relationships: Relationships Motivation Theory. In N. Weinstein, ed. *Human Motivation and Interpersonal Relationships*. Dordrecht: Springer:53–73.

Deci, E.L., Ryan, R.M. & Williams, G.C. 1996. Need satisfaction and the self-regulation of learning. *Learning and Individual Differences.* 8(3):165–183.

Deci, E.L., Vallerand, R.J., Pelletier, L.G. & Ryan, R.M. 1991. Motivation and education: The self-determination perspective. *Educational Psychologist.* 26(3–4):325–346.

Decker, A. & Lawley, E.L. 2013. Life's a game and the game of life: how making a game out of it can change student behavior. In T. Camp, ed. *Proceeding of the 44th ACM technical symposium on Computer science education*. SIGCSE '13. Denver: ACM:233–238. [Online] Available at: https://dl.acm.org/citation.cfm?id=2445269 [Accessed 15 September 2015].

Denny, P. 2013. The Effect of Virtual Achievements on Student Engagement. In W. Mackay, ed. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '13. CHI '13. Paris: ACM:763–772. [Online] Available at: https://dl.acm.org/citation.cfm?id=2470763 [Accessed 26 January 2016].

Denzin, N.K. & Lincoln, Y.S. 2017. Introduction: The Discipline and Practice of Qualitative Research. In N. K. Denzin & Y. S. Lincoln, eds. *The SAGE Handbook of Qualitative Research*. Thousand Oaks: SAGE Publications, Inc.:1–32.

Desmet, P.M. & Pohlmeyer, A.E. 2013. Positive design: An introduction to design for subjective well-being. *International Journal of Design.* 7(3):5–19.

Desurvire, H. & Wiberg, C. 2009. Game Usability Heuristics (PLAY) for Evaluating and Designing Better Games: The Next Iteration. In A. A. Ozok & P. Zaphiris, eds. *Online Communities and Social Computing*. Lecture Notes in Computer Science. OCSC 2009. Berlin: Springer:557–566. [Online] Available at: https://link.springer.com/chapter/10.1007%2F978-3-642-02774-1_60 [Accessed 12 May 2016].

Deterding, S. 2012. Persuasive Design. In C. Wiedemann, N. Rossiter, & S. Zehle, eds. *Depletion Design: A Glossary of Network Ecologies*. Amsterdam: Institute of Network Cultures:115–119.

Deterding, S. 2014. Eudaimonic Design, or: Six Invitations to Rethink Gamification. In M. Fuchs, S. Fizek, P. Ruffino, & N. Schrape, eds. *Rethinking Gamification.* Lüneburg: meson press:305–323.

Deterding, S. 2015. The lens of intrinsic skill atoms: A method for gameful design. *Human-Computer Interaction.* 30(3–4):294–335.

Deterding, S., Dixon, D., Khaled, R. & Nacke, L. 2011. From game design elements to gamefulness: defining gamification. In A. Lugmayr, H. Franssila, O. Sotamaa, C. Safran, & T. Aaltonen, eds. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*. MindTrek '11. Tampere: ACM:9–15. [Online] Available at: https://dl.acm.org/citation.cfm?id=2181040 [Accessed 23 July 2015].

Dichev, C., Dicheva, D., Angelova, G. & Agre, G. 2014. From gamification to gameful design and gameful experience in learning. *Cybernetics and Information Technologies.* 14(4):80–100.

DiTommaso, D. 2011. Beyond Gamification: Architecting Engagement Through Game Design Thinking. [Online] Available at: http://www.slideshare.net/ditommaso/beyond-gamification-architecting-engagement-through-game-design-thinking [Accessed 17 November 2015].

Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C. & Martínez-Herráiz, J.J. 2013. Gamifying learning experiences: Practical implications and outcomes. *Computers & Education.* 63:380–392.

Egenfeldt-Nielsen, S., Smith, J.H. & Tosca, S.P. 2009. *Understanding Video Games: The Essential Introduction.* 1st ed. New York: Routledge.

Elliot, A.J. & Church, M.A. 1997. A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology.* 72(1):218–232.

Ertmer, P.A. & Newby, T.J. 1993. Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly.* 26(2):50–72.

Ferrara, J. 2013. Games for Persuasion Argumentation, Procedurality, and the Lie of Gamification. *Games and Culture.* 8(4):289–304.

Fidel, R. 1984. A Case Study Method: A Case Study. *Library and Information Science Research* 6:273–288.

Fitz-Walter, Z. 2015. *Achievement unlocked: Investigating the design of effective gamification experiences for mobile applications and devices.* . PhD thesis. Queensland: Queensland University of Technology. [Online] Available at: https://eprints.qut.edu.au/83675/ [Accessed 1 August 2017].

Flick, U. 2009. *An Introduction to Qualitative Research*. 4th ed. Los Angeles: SAGE Publications, Inc.

Flink, C., Boggiano, A.K. & Barrett, M. 1990. Controlling teaching strategies: Undermining children's self-determination and performance. *Journal of Personality and Social Psychology*. 59(5):916–924.

Fry, H., Ketteridge, S. & Marshal, S. 2008. *A Handbook for Teaching and Learning in Higher Education*. New York: Taylor & Francis.

Fullerton, T. 2008. *Game Design Workshop: A Playcentric Approach to Creating Innovative Games*. 2nd ed. Burlington: Elsevier/Morgan Kaufmann.

Funnell, S.C. & Rogers, P.J. 2011. *Purposeful Program Theory: Effective Use of Theories of Change and Logic Models*. San Francisco: John Wiley & Sons.

Gagné, M. & Deci, E.L. 2005. Self-determination theory and work motivation. *Journal of Organizational Behavior*. 26(4):331–362.

Gaver, W.W., Bowers, J., Boucher, A., Gellerson, H., Pennington, S., Schmidt, A., Steed, A., Villars, N. & Walker, B. 2004. The drift table: designing for ludic engagement. In E. Dykstra-Erickson, ed. *CHI '04 Extended Abstracts on Human Factors in Computing Systems*. CHI EA '04. Vienna: ACM:885–900. [Online] Available at: http://dl.acm.org/citation.cfm?id=985947 [Accessed 10 June 2017].

Gee, J.P. 2003. *What Video Games Have to Teach Us about Learning and Literacy*. New York: Palgrave Macmillan.

Glover, I. 2013. Play as you learn: gamification as a technique for motivating learners. In J. Herrington, A. Couros, & V. Irvine, eds. *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications*. EdMedia: World Conference on Educational Media and Technology. Chesapeake: Association for the Advancement of Computing in Education (AACE):1999–2008. [Online] Available at: https://shura.shu.ac.uk/7172/ [Accessed 28 October 2015].

Goehle, G. 2013. Gamification and web-based homework. *Primus*. 23(3):234–246.

Gorman, G.E., Clayton, P.R., Shep, S.J. & Clayton, A. 2005. *Qualitative Research for the Information Professional: A Practical Handbook*. 2nd ed. London: Facet Publishing.

Gould, J.D. & Lewis, C. 1985. Designing for usability: key principles and what designers think. *Communications of the ACM*. 28(3):300–311.

Grolnick, W.S. & Ryan, R.M. 1989. Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology.* 81(2):143–154.

Haggard, P. 2008. Human volition: towards a neuroscience of will. *Nature Reviews Neuroscience.* 9(12):934–946.

Hallford, N. & Hallford, J. 2001. *Swords & Circuitry: A Designer's Guide to Computer Role Playing Games*. Roseville: Prima Tech.

Hamari, J., Koivisto, J. & Sarsa, H. 2014. Does Gamification Work? – A Literature Review of Empirical Studies on Gamification. In R. Sprague, ed. *2014 47th Hawaii International Conference on System Sciences*. HICSS. Waikoloa: IEEE:3025–3034. [Online] Available at: https://ieeexplore.ieee.org/abstract/document/6758978/ [Accessed 23 July 2015].

Hanna, D., David, I. & Francisco, B. 2010. *Educational Research and Innovation The Nature of Learning Using Research to Inspire Practice: Using Research to Inspire Practice*. Paris: OECD Publishing.

Hanus, M.D. & Fox, J. 2015. Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. *Computers & Education.* 80:152–161.

Heider, F. 1958. *The Psychology of Interpersonal Relations*. New York: Wiley.

Hennessy, S. 1993. Situated cognition and cognitive apprenticeship: Implications for classroom learning. *Studies in Science Education* 22(1):1–41.

Herrington, A. & Herrington, J. 2006. *Authentic Learning Environments in Higher Education*. Hershey: Information Science Publishing.

Heyman, G.D. & Dweck, C.S. 1992. Achievement goals and intrinsic motivation: Their relation and their role in adaptive motivation. *Motivation and Emotion.* 16(3):231–247.

Hofstee, E. 2006. *Constructing a good dissertation: a practical guide to finishing a Master's, MBA or PhD on schedule*. Johannesburg: EPE Publishers.

Holman, C., Aguilar, S. & Fishman, B. 2013. GradeCraft: What can we learn from a game-inspired learning management system? In D. Suthers, ed. *Proceedings of the Third International Conference on Learning Analytics and Knowledge*. LAK '13. Leuven: ACM:260–264. [Online] Available at: http://dl.acm.org/citation.cfm?id=2460350.

Hughes, M. & Lacy, C.J. 2016. " The Sugar'd Game before Thee": Gamification Revisited. *portal: Libraries and the Academy.* 16(2):311–326.

Huizinga, J. 1949. *Homo Ludens: Homo Ludens: A Study of the Play Element in Culture*. London: Routledge & Kegan Paul Ltd.

Hunicke, R., LeBlanc, M. & Zubek, R. 2004. MDA: A formal approach to game design and game research. In M. Hauskrecht, ed. *Proceedings of the AAAI Workshop on Challenges in Game AI*. National Conference on Artificial Intelligence. San Jose: AAAI Press:1–5. [Online] Available at: http://www.aaai.org/Papers/Workshops/2004/WS-04-04/WS04-04-001.pdf [Accessed 3 December 2014].

Huotari, K. & Hamari, J. 2012. Defining Gamification: A Service Marketing Perspective. In A. Lugmayr, ed. *Proceeding of the 16th International Academic MindTrek Conference*. MindTrek '12. Tampere: ACM:17–22. [Online] Available at: https://dl.acm.org/citation.cfm?id=2393137 [Accessed 23 July 2015].

Huotari, K. & Hamari, J. 2016. A definition for gamification: anchoring gamification in the service marketing literature. *Electronic Markets.* 27(1):1–11.

Ibanez, 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.

Jacobson, J. 2003. Using "CaveUT" to Build Immersive Displays with the Unreal Tournament Engine and a PC Cluster. In M. Zyda & M. Capps, eds. *Proceedings of the 2003 Symposium on Interactive 3D Graphics*. I3D '03. Monterey: ACM:221–222. [Online] Available at: http://doi.acm.org/10.1145/641480.641524 [Accessed 25 April 2016].

Järvinen, A. 2008. *Games without frontiers: Theories and methods for game studies and design*. . PhD thesis. Tampere: Tampere University Press.

Johnson-Laird, P.N. 1983. *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness*. Cambridge: Harvard University Press.

Kafai, Y.B., Franke, M.L., Ching, C.C. & Shih, J.C. 1998. Game design as an interactive learning environment for fostering students' and teachers' mathematical inquiry. *International Journal of Computers for Mathematical Learning.* 3(2):149–184.

Kankaanranta, M.H. & Neittaanmäki, P. 2008. *Design and Use of Serious Games*. Dordrecht: Springer.

Kappen, D. & Nacke, L. 2013. The Kaleidoscope of Effective Gamification: Deconstructing Gamification in Business Applications. In L. E. Nacke, ed. *Proceedings of the First International Conference on Gameful Design, Research, and Applications*. Gamification '13. Toronto: ACM:119–122. [Online] Available at: https://dl.acm.org/citation.cfm?id=2583029 [Accessed 13 January 2016].

Kaufman, A. & Dodge, T. 2009. Student perceptions and motivation in the classroom: Exploring relatedness and value. *Social Psychology of Education.* 12(1):101–112.

Kim, K., Schmierbach, M.G., Bellur, S., Chung, M.-Y., Fraustino, J.D., Dardis, F. & Ahern, L. 2015. Is it a sense of autonomy, control, or attachment? Exploring the effects of in-game customization on game enjoyment. *Computers in Human Behavior.* 48:695–705.

Klock, A.C.T., da Cunha, L.F., de Carvalho, M.F. de, Rosa, B.E., Anton, A.J. & Gasparini, I. 2015. Gamification in e-Learning Systems: A Conceptual Model to Engage Students and Its Application in an Adaptive e-Learning System. In P. Zaphiris & A. Ioannou, eds. *Second International Conference of Learning and Collaboration Technologies*. Lecture Notes in Computer Science. International Conference on Learning and Collaboration Technologies. Los Angeles: Springer, Cham:595–607. [Online] Available at: https://link.springer.com/chapter/10.1007/978-3-319-20609-7_56 [Accessed 1 August 2017].

Knaving, K., Björk, S. & Nacke, L.E. 2013. Designing for Fun and Play: Exploring Possibilities in Design for Gamification. In L. E. Nacke, ed. *Proceedings of the First International Conference on Gameful Design, Research, and Applications*. Gamification '13. Toronto: ACM:131–134. [Online] Available at: https://dl.acm.org/citation.cfm?id=2583032 [Accessed 23 July 2015].

Knowlton, L.W. & Phillips, C. 2008. *The Logic Model Guidebook: Better Strategies for Great Results*. Thousand Oaks: SAGE Publications, Inc.

Konzack, L. 2002. Computer Game Criticism: A Method for Computer Game Analysis. In F. Mayra, ed. *CGDC Conference Proceedings*. CGDC. Tampere: Tampere University Press:89–100. [Online] Available at: https://goo.gl/FQ6mG8 [Accessed 23 April 2015].

Koster, R. 2004. *Theory of Fun for Game Design*. Sebastopol: O'Reilly Media, Inc.

Kotini, I. & Tzelepi, S. 2015. A Gamification-Based Framework for Developing Learning Activities of Computational Thinking. In T. Reiners & W. Lincoln C., eds. *Gamification in Education and Business*. Switzerland: Springer International Publishing:219–252. [Online] Available at: https://link.springer.com/chapter/10.1007/978-3-319-10208-5_12 [Accessed 1 August 2017].

La Guardia, J.G. & Patrick, H. 2008. Self-determination theory as a fundamental theory of close relationships. *Canadian Psychology/Psychologie canadienne.* 49(3):201–209.

Leedy, P.D. & Ormrod, J.E. 2012. *Practical research: planning and design.* New Jersey: Prentice Hall.

Lepouras, G. & Vassilakis, C. 2004. Virtual museums for all: employing game technology for edutainment. *Virtual Reality.* 8(2):96–106.

Lepper, M.R., Greene, D. & Nisbett, R.E. 1973. Undermining children's intrinsic interest with extrinsic reward: A test of the" overjustification" hypothesis. *Journal of Personality and Social Psychology.* 28(1):129–137.

Lewis, M. & Wray, D. 2005. *Extending Literacy: Developing Approaches to Non-Fiction*. London: Routledge.

Lipsey, M.W. 1993. Theory as method: Small theories of treatments. *New Directions for Evaluation.* 1993(57):5–38.

Lombardi, M.M. 2007. Authentic learning for the 21st century: An overview. *Educause Learning Initiative.* 1(2007):1–12.

Lucero, A. & Arrasvuori, J. 2010. PLEX Cards: A Source of Inspiration when Designing for Playfulness. In V. V. Abeele, ed. *Proceedings of the 3rd International Conference on Fun and Games*. Fun and Games '10. Leuven: ACM:28–37. [Online] Available at: https://dl.acm.org/citation.cfm?id=1823821 [Accessed 26 August 2015].

Lucero, A., Holopainen, J., Ollila, E., Suomela, R. & Karapanos, E. 2013. The playful experiences (PLEX) framework as a guide for expert evaluation. In M. Blythe, ed. *Proceedings of the 6th International Conference on Designing Pleasurable Products and Interfaces*. DPPI '13. Newcastle upon Tyne: ACM:221–230. [Online] Available at: http://dl.acm.org/citation.cfm?id=2513530 [Accessed 11 May 2017].

Lucero, A., Karapanos, E., Arrasvuori, J. & Korhonen, H. 2014. Playful or Gameful?: Creating Delightful User Experiences. *interactions.* 21(3):34–39.

Lundgren, S. & Björk, S. 2003. Game mechanics: describing computer-augmented games in terms of interaction. In S. Goebel, ed. *Proceeding of TIDSE 2003*. 1st International Conference on Technologies for Interactive Digital Storytelling and Entertainment. Darmstadt: Springer:1–12. [Online] Available at: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.100.6888 [Accessed 23 April 2015].

Mageau, G.A. & Vallerand, R.J. 2003. The coach–athlete relationship: A motivational model. *Journal of Sports Science* 21(11):883–904.

Malliet, S. & de Meyer, G. 2005. The History of the Video Game. In J. Raessens & J. Goldstein, eds. *Handbook of Computer Game Studies*. Cambridge: MIT Press:23–45.

Malone, T.W. 1981. Toward a theory of intrinsically motivating instruction. *Cognitive Science.* 5(4):333–369.

Manrique, V. 2013. Gamification Design Framework: The SMA Model. *Gamasutra*. [Online] Available at: http://www.gamasutra.com/blogs/VictorManrique/20130618/194563/Gamification_Design_Framework_The_SMA_Model.php [Accessed 2 August 2017].

Mao, J.-Y., Vredenburg, K., Smith, P.W. & Carey, T. 2005. The state of user-centered design practice. *Communications of the ACM - The disappearing computer.* 48(3):105–109.

Marache-Francisco, C. & Brangier, E. 2013. Process of Gamification From The Consideration of Gamification To Its Practical Implementation. In L. Bertzen, ed. *Proceedings of the Sixth International Conference on Advances in Human-oriented and Personalized Mechanisms, Technologies, and Services*. CENTRIC 2013. Venice: International Academy, Research, and Industry Association (IARIA):126–131. [Online] Available at: academia.edu.documents/46418928 [Accessed 6 October 2015].

Marczewski, A. 2013. *Gamification: A Simple Introduction*. Online: Andrzej Marczewski.

McDaniel, R., Lindgren, R. & Friskics, J. 2012. Using badges for shaping interactions in online learning environments. In *2012 IEEE International Professional Communication Conference*. IPCC. Orlando: IEEE:1–4. [Online] Available at: https://ieeexplore.ieee.org/abstract/document/6408619/ [Accessed 27 September 2016].

McGonigal, J. 2011. *Reality is broken: why games make us better and how they can change the world*. New York: Penguin Press.

McGonigal, J. 2014. I'm not Playful, I'm Gameful. In S. L. Björk & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:653–657.

McVee, M.B., Dunsmore, K. & Gavelek, J.R. 2005. Schema theory revisited. *Review of Educational Research.* 75(4):531–566.

Merriam, S.B. 2009. *Qualitative Research and Case Study Applications in Education: Revised and Expanded from Case Study Research in Education*. 2nd ed. San Francisco: Jossey-Bass.

Merriam, S.B. 2016. *Qualitative Research: A Guide to Design and Implementation*. 4th ed. San Francisco: Jossey-Bass.

Meyer, B. & Sørensen, B.H. 2009. Designing Serious Games for Computer Assisted Language Learning – a Framework for Development and Analysis. In M. Kankaanranta & P. Neittaanmäki, eds. *Design and use of serious games*. Intelligent Systems, Control, and Automation: Science and Engineering. Dordrecht: Springer:69–82. [Online] Available at: http://link.springer.com/chapter/10.1007/978-1-4020-9496-5_5 [Accessed 18 May 2017].

Michael, D.R. & Chen, S.L. 2005. *Serious Games: Games That Educate, Train, and Inform*. Boston: Thompson Course Technology.

Miles, M.B. & Huberman, A.M. 1994. *Qualitative data analysis: an expanded sourcebook*. Thousand Oaks: Sage Publications.

Mora, A., Riera, D., González, C. & Arnedo-Moreno, J. 2015. A literature review of gamification design frameworks. In P. Backlund & H. Engström, eds. *2015 7th International Conference on Games and Virtual Worlds for Serious Applications*. VS-GAMES. Skövde: IEEE:1–8. [Online] Available at: https://ieeexplore.ieee.org/abstract/document/7295760/ [Accessed 6 October 2015].

Mora, A., Riera, D., González, C. & Arnedo-Moreno, J. 2017. Gamification: a systematic review of design frameworks. *Journal of Computing in Higher Education*. 29:516–548.

Mora, A., Zaharias, P., González, C. & Arnedo-Moreno, J. 2015. Fraggle: a framework for agile gamification of learning experiences. In A. De Gloria & R. Veltkamp, eds. *Games and Learning Alliance*. Lecture Notes in Computer Science. GALA 2015. Rome: Springer, Cham:530–539. [Online] Available at: http://link.springer.com/chapter/10.1007/978-3-319-40216-1_57 [Accessed 1 August 2017].

Morgan, D.L., Krueger, R.A. & King, J.A. 1998. *Developing Questions for Focus Groups*. Thousand Oaks: SAGE Publications, Inc.

Morschheuser, B., Werder, K., Hamari, J. & Julian, A. 2017. How to gamify? A method for designing gamification. In *Proceedings of the 50th Hawaii International Conference on System Sciences*. HICSS 2017. Hilton Waikoloa Village: IEEE:1298–1307. [Online] Available at: http://hdl.handle.net/10125/41308 [Accessed 2 August 2017].

Mouton, J. 2001. *How to succeed in your master's and doctoral studies: a South African guide and resource book*. Pretoria: Van Schaik.

Murayama, K., Matsumoto, M., Izuma, K. & Matsumoto, K. 2010. Neural basis of the undermining effect of monetary reward on intrinsic motivation. *Proceedings of the National Academy of Sciences* 107(49):20911–20916.

Nah, F.F.-H., Zeng, Q., Telaprolu, V.R., Ayyappa, A.P. & Eschenbrenner, B. 2014. Gamification of education: a review of literature. In F. F.-H. Nah, ed. *International Conference on HCI in Business*. Lecture Notes in Computer Science. HCIB 2014. Heraklion: Springer:401–409. [Online] Available at: https://link.springer.com/chapter/10.1007%2F978-3-319-07293-7_39 [Accessed 27 June 2017].

Nicholson, S. 2012. A user-centered theoretical framework for meaningful gamification. In C. Martin, A. Ochsner, & K. Squire, eds. *Games + Learning + Society (GLS) Conference 8.0*. Games + Learning + Society Conference 8.0. Madison: ETC Press:1–1. [Online] Available at: http://www.quilageo.com/wp-content/uploads/2013/07/Framework-for-Meaningful-Gamifications.pdf [Accessed 10 September 2015].

Nicholson, S. 2015. A recipe for meaningful gamification. In T. Reiners & L. C. Wood, eds. *Gamification in Education and Business*. Switzerland: Springer, Cham:1–20. [Online] Available at: https://link.springer.com/chapter/10.1007%2F978-3-319-10208-5_1 [Accessed 13 January 2016].

Niemiec, C.P. & Ryan, R.M. 2009. Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education.* 7(2):133–144.

Norman, D., Miller, J. & Henderson, A. 1995. What you see, some of what's in the future, and how we go about doing it: HI at Apple Computer. In I. Katz, ed. *CHI' Companion 95*. CHI '95 Mosaic of Creativity. Denver: ACM:155. [Online] Available at: https://www.researchgate.net/profile/Donald_Norman/publication/202165701_What_You_See_Some_of_What's_in_the_Future_And_How_We_Go_About_Doing_It_HI_at_Apple_Computer/links/565a122808ae4988a7b96b97.pdf.

O'Donovan, S., Gain, J. & Marais, P. 2013. A Case Study in the Gamification of a University-level Games Development Course. In J. McNeill & K. Bradshaw, eds. *Proceedings of the South African Institute for Computer Scientists and Information Technologists Conference*. SAICSIT '13. SAICSIT '13. East London: ACM:242–251. [Online] Available at: https://dl.acm.org/citation.cfm?id=2513469 [Accessed 23 July 2015].

Paharia, R. 2012. Who coined the term "gamification"? *Quora*. [Online] Available at: https://goo.gl/ZUJ1nq [Accessed 20 April 2015].

Paisley, V. 2013. Gamification of tertiary courses: An exploratory study of learning and engagement. In H. Carter & J. Hedberg, eds. *Proceedings of the 30th ASCILITE Conference*. ASCILITE. Sydney: Australasian Society for Computers in Learning in Tertiary Education:671–675. [Online] Available at: http://ascilite.org/conferences/sydney13/program/papers/Paisley.pdf [Accessed 4 November 2015].

Pelletier, L.G., Fortier, M.S., Vallerand, R.J. & Brière, N.M. 2001. Associations Among Perceived Autonomy Support, Forms of Self-Regulation, and Persistence: A Prospective Study. *Motivation and Emotion.* 25(4):279–306.

Peng, W., Lin, J.-H., Pfeiffer, K.A. & Winn, B. 2012. Need satisfaction supportive game features as motivational determinants: An experimental study of a self-determination theory guided exergame. *Media Psychology.* 15(2):175–196.

Piaget, J. 1954. *The Construction Of Reality In The Child*. Abingdon: Routledge.

Pickard, A.J. 2013. *Research methods in information*. London: Facet.

Pink, D.H. 2009. *Drive: The Surprising Truth About What Motivates Us*. New York: Riverhead Books.

Pittman, T.S. & Zeigler, K.R. 2007. Basic human needs. In A. Kruglanski & E. T. Higgins, eds. *Social Psychology: Handbook of Basic Principles*. New York: The Guilford Press:473–489.

Pritchard, A. 2009. *Ways of Learning: Learning Theories and Learning Styles in the Classroom*. 2nd ed. London: Routledge.

Przybylski, A.K., Rigby, C.S. & Ryan, R.M. 2010. A motivational model of video game engagement. *Review of General Psychology.* 14(2):154–166.

Raessens, J. 2006. Playful identities, or the ludification of culture. *Games and Culture.* 1(1):52–57.

Raessens, J. 2010. Homo Ludens 20: The Ludic Turn in Media Theory. *Utrecht University Repository.* 5:64–69.

Ramirez, D. & Squire, K. 2015. Gamification and Learning. In S. L. Björk & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:629–652.

Rapp, A. 2017. From games to gamification: A classification of rewards in World of Warcraft for the design of gamified systems. *Simulation & Gaming.* 48(3):381–401.

Ratan, R. & Ritterfeld, U. 2009. Classifying serious games. In U. Ritterfeld, M. Cody, & P. Vorderer, eds. *Serious games: Mechanisms and effects.* New York: Routledge:10–24.

Reeve, J. 2009. *Understanding motivation and emotion*. 5th ed. Hoboken: John Wiley & Sons.

Reeve, J. & Jang, H. 2006. What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*. 98(1):209–218.

Richter, G., Raban, D.R. & Rafaeli, S. 2014. Studying gamification: the effect of rewards and incentives on motivation. In T. Reiners & L. C. Wood, eds. *Gamification in Education and Business*. Switzerland: Springer, Cham:21–46. [Online] Available at: http://link.springer.com/chapter/10.1007/978-3-319-10208-5_2 [Accessed 6 October 2016].

Rieber, L.P. 1996. Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational technology research and development*. 44(2):43–58.

Rigby, S. 2015. Gamification and motivation. In S. L. Björk & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:113–137.

Rigby, S. & Ryan, R. 2011. *Glued to games: how video games draw us in and hold us spellbound*. Santa Barbara: ABC-CLIO.

Robertson, M. 2010. Can't play, won't play. *Hide&Seek*. [Online] Available at: http://hideandseek.net/2010/10/06/cant-play-wont-play/ [Accessed 23 May 2016].

Robinson, D. & Bellotti, V. 2013. A preliminary taxonomy of gamification elements for varying anticipated commitment. In W. Mackay, ed. *Proc. ACM CHI 2013 Workshop on Designing Gamification: Creating Gameful and Playful Experiences*. CHI 2013. Paris: ACM. [Online] Available at: http://gamification-research.org/wp-content/uploads/2013/03/Robinson_Bellotti.pdf [Accessed 19 October 2015].

Robson, K., Plangger, K., Kietzmann, J.H., McCarthy, I. & Pitt, L. 2015. Is it all a game? Understanding the principles of gamification. *Business Horizons*. 58(4):411–420.

Rogers, Y., Sharp, H. & Preece, J. 2015. *Interaction Design: Beyond Human-Computer Interaction*. 4th ed. Chichester: Wiley.

Rouse III, R. & Odgen, S. 2005. *Game Design: Theory and Practice*. 2nd ed. Plano: Wordware Publishing.

Royce, W.W. 1987. Managing the development of large software systems: concepts and techniques. In W. Riddle, ed. *Proceedings of the 9th International Conference on Software Engineering*. ICSE '87. Monterey: IEEE:328–338. [Online] Available at:

http://leadinganswers.typepad.com/leading_answers/files/original_waterfall_paper_winston_royce.pdf [Accessed 25 August 2017].

Ruparelia, N.B. 2010. Software development lifecycle models. *ACM SIGSOFT Software Engineering Notes.* 35(3):8–13.

Ryan, R., Williams, G.C., Patrick, H. & Deci, E.L. 2009. Self-Determination Theory and Physical Activity: The Dynamics of Motivation in Development and Wellness. *Hellenic Journal of Psychology.* 6:107–124.

Ryan, R.M. 1982. Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology.* 43(3):450–461.

Ryan, R.M. & Connell, J.P. 1989. Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology.* 57(5):749–761.

Ryan, R.M. & Deci, E.L. 2000a. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology.* 25(1):54–67.

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

Ryan, R.M. & Deci, E.L. 2017. *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness.* New York: Guilford Press.

Ryan, R.M., Huta, V. & Deci, E.L. 2008. Living well: A self-determination theory perspective on eudaimonia. *Journal of Happiness Studies.* 9(1):139–170.

Ryan, R.M., Mims, V. & Koestner, R. 1983. Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive evaluation theory. *Journal of Personality and Social Psychology.* 45(4):736–750.

Ryan, R.M., Rigby, C.S. & Przybylski, A. 2006. The Motivational Pull of Video Games: A Self-Determination Theory Approach. *Motivation and Emotion.* 30(4):344–360.

Sailer, M., Hense, J., Mandl, H. & Klevers, M. 2013. Psychological Perspectives on Motivation through Gamification. *Interaction Design and Architecture.* 19:28–37.

Sakamoto, M., Nakajima, T. & Alexandrova, T. 2012. Value-based design for gamifying daily activities. In M. Herrlich, R. Malaka, & M. Masuch, eds. *Entertainment Computing-ICEC 2012.* Lecture notes in computer science. International Conference on Entertainment Computing. Bremen: Springer:421–424. [Online] Available at:

https://link.springer.com/chapter/10.1007%2F978-3-642-33542-6_43 [Accessed 10 September 2015].

Salen, K. & Zimmerman, E. 2003. *Rules of play: game design fundamentals*. Cambridge: MIT Press.

Schell, J. 2008. *The Art of Game Design: A Book of Lenses*. 2nd ed. Boca Raton: CRC Press.

Schneiderman, B. 2004. Designing for Fun: How Can We Design User Interfaces to Be More Fun? *interactions*. 11(5):48–50.

Schreuders, Z.C. & Butterfield, E. 2016. Gamification for teaching and learning computer security in higher education. In M. Gondree & Z. N. J. Peterson, eds. *2016 USENIX Workshop on Advances in Security Education*. ASE 16. Austin: USENIX Association:1–8. [Online] Available at: https://www.usenix.org/conference/ase16/workshop-program/presentation/schreuders [Accessed 6 October 2016].

Schunk, D. 2011. *Learning Theories: An Educational Perspective*. 6th ed. Boston: Pearson Education.

Scott, B. 2010. Designing with Lenses. *UX Booth*. [Online] Available at: http://www.uxbooth.com/articles/designing-with-lenses/ [Accessed 3 August 2017].

Seaborn, K. & Fels, D.I. 2015. Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*. 74:14–31.

Selinger, M. 2001. Setting authentic tasks using the internet in schools. In M. Leask, ed. *Issues in Teaching Using ICT*. London: RoutledgeFalmer:96–104.

Shuell, T.J. 1986. Cognitive Conceptions of Learning. *Review of Educational Research*. 56(4):411–436.

Sicart, M. 2008. Defining game mechanics. *Game Studies*. 8(2):1–14.

Silpasuwanchai, C., Ma, X., Shigemasu, H. & Ren, X. 2016. Developing a comprehensive engagement framework of gamification for reflective learning. In M. Foth, ed. *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*. DIS '16. Brisbane: ACM:459–472. [Online] Available at: https://dl.acm.org/citation.cfm?id=2901836 [Accessed 10 May 2017].

Silverman, D. 2010. *Doing Qualitative Research: A Practical Handbook*. 3rd ed. London; Los Angeles: SAGE Publications, Inc.

Simões, J., Redondo, R.D. & Vilas, A.F. 2013. A social gamification framework for a K-6 learning platform. *Computers in Human Behavior*. 29(2):345–353.

Skinner, B.F. 1963. Operant behavior. *American Psychologist*. 18(8):503–515.

Song, D., Ju, P. & Xu, H. 2017. Engaged Cohorts: Can Gamification Engage All College Students in Class? *Eurasia Journal of Mathematics, Science and Technology Education*. 13(7):3723–3734.

Songer, R.W. & Miyata, K. 2014. A Playful Affordances Model for Gameful Learning. In F. J. García-Peñalvo, ed. *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*. TEEM '14. Salamanca: ACM:205–213. [Online] Available at: https://dl.acm.org/citation.cfm?id=2669901 [Accessed 14 April 2016].

Squire, K. 2006. From content to context: Videogames as designed experience. *Educational researcher*. 35(8):19–29.

Stake, R. 1995. *The Art of Case Study Research*. Thousand Oaks: SAGE Publications, Inc.

Stake, R.E. 2006. *Multiple Case Study Analysis*. New York: Guilford Press.

Stenros, J., Montola, M. & Mäyrä, F. 2007. Pervasive games in ludic society. In B. Kapralos, M. Katchabaw, & J. Rajnovich, eds. *Proceedings of the 2007 conference on Future Play*. Future Play '07. Toronto: ACM:30–37. [Online] Available at: https://dl.acm.org/citation.cfm?id=1328209 [Accessed 11 May 2017].

Stott, A. & Neustaedter, C. 2013. Analysis of gamification in education. *Surrey, BC, Canada* 8:36–44.

Suits, B. 1978. *The Grasshopper: Games, Life and Utopia*. 3rd ed. Toronto: Broadview Press.

Sundar, S.S. & Marathe, S.S. 2010. Personalization versus customization: The importance of agency, privacy, and power usage. *Human Communication Research*. 36(3):298–322.

Susi, T., Johannesson, M. & Backlund, P. 2007. Serious Games: An Overview. *Institutionen för kommunikation och information*:1–24.

Tamborini, R., Bowman, N.D., Eden, A., Grizzard, M. & Organ, A. 2010. Defining media enjoyment as the satisfaction of intrinsic needs. *Journal of Communication*. 60(4):758–777.

Taylor, T.L. 2009. The assemblage of play. *Games and Culture*. 4(4):331–339.

Teixeira, P.J., Carraça, E.V., Markland, D., Silva, M.N. & Ryan, R.M. 2012. Exercise, physical activity, and self-determination theory: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*. 9:1–30.

Trist, E. 1981. The evolution of socio-technical systems. *Occasional paper*. 2:1–67.

Vallerand, R.J., Pelletier, L.G., Blais, M.R., Briere, N.M., Senecal, C. & Vallieres, E.F. 1992. The Academic Motivation Scale: A measure of intrinsic, extrinsic, and amotivation in education. *Educational and Psychological Measurement*. 52(4):1003–1017.

Vallerand, R.J., Pelletier, L.G. & Koestner, R. 2008. Reflections on self-determination theory. *Canadian Psychology/Psychologie canadienne*. 49(3):257–262.

Van Eck, R. 2006. Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE review*. 41(2):1–16.

Van Roy, R. & Zaman, B. 2017. Why Gamification Fails in Education and How to Make It Successful: Introducing Nine Gamification Heuristics Based on Self-Determination Theory. In M. Ma & A. Oikonomou, eds. *Serious Games and Edutainment Applications*. Berlin: Springer:485–509. [Online] Available at: http://link.springer.com/chapter/10.1007/978-3-319-51645-5_22 [Accessed 2 May 2017].

Vansteenkiste, M., Lens, W. & Deci, E.L. 2006. Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational psychologist*. 41(1):19–31.

Vansteenkiste, M., Neyrinck, B., Niemiec, C.P., Soenens, B., Witte, H. & Broeck, A. 2007. On the relations among work value orientations, psychological need satisfaction and job outcomes: A self-determination theory approach. *Journal of Occupational and Organizational Psychology*. 80(2):251–277.

Vansteenkiste, M., Niemiec, C.P. & Soenens, B. 2010. The development of the five mini-theories of self-determination theory: An historical overview, emerging trends, and future directions. In T. C. Urdan & S. A. Karabenick, eds. *The decade ahead: Theoretical perspectives on motivation and achievement*. Bingley: Emerald:105–165.

Versteeg, M.J.J.. 2013. *Ethics & Gamification design: a moral framework for taking responsibility*. . PhD thesis. Utrecht University. [Online] Available at: http://dspace.library.uu.nl/handle/1874/281831 [Accessed 18 November 2015].

von Ahn, L. & Dabbish, L. 2008. Designing games with a purpose. *Communications of the ACM*. 51(8):58–67.

Vos, A.S.D., Strydom, H., Fouché, C.B. & Delport, C.S.L. 2011. *Research at Grass Roots: For the Social Sciences and Human Service Professions*. Pretoria: Van Schaik Publishers.

Vygotsky, L.S. 1978. *Mind in Society: The Development of Higher Psychological Processes*. Cambridge: Harvard University Press.

Walz, S. & Deterding, S. 2014. Introduction to the Gameful World. In S. P. Walz & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:1–13.

Werbach, K. 2014. (Re)Defining Gamification: A Process Approach. In A. Spagnolli, L. Chittaro, & L. Gamberini, eds. *International Conference on Persuasive Technology*. PERSUASIVE 2014: Persuasive Technology. Padua: Springer, Cham:266–272. [Online] Available at: https://link.springer.com/chapter/10.1007%2F978-3-319-07127-5_23#citeas [Accessed 4 February 2016].

Werbach, K. & Hunter, D. 2012. *For the Win: How Game Thinking Can Revolutionize Your Business*. Philadelphia: Wharton Digital Press.

Whitton, N. 2014. *Digital Games and Learning: Research and Theory*. New York: Routledge.

Williams, G.C. & Deci, E.L. 1996. Internalization of biopsychosocial values by medical students: a test of self-determination theory. *Journal of Personality and Social Psychology*. 70(4):767–779.

Williams, G.C., Freedman, Z. & Deci, E. 1998. Supporting Autonomy to Motivate Patients with Diabetes for Glucose Control. *Diabetes Care*. 21(10):1644–1651.

Williams, G.C., Grow, V.M., Freedman, Z.R., Ryan, R.M. & Deci, E.L. 1996. Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*. 70(1):115–126.

Wongso, O., Rosmansyah, Y. & Bandung, Y. 2014. Gamification framework model, based on social engagement in e-learning 20. In A. Turnip, ed. *2014 2nd International Conference on Technology, Informatics, Management, Engineering Environment*. TIME-E 2014. Bandung: IEEE:10–14. [Online] Available at: https://ieeexplore.ieee.org/abstract/document/7011583/ [Accessed 1 August 2017].

Wood, D., Bruner, J.S. & Ross, G. 1976. The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*. 17(2):89–100.

Yin, R.K. 2013. *Case Study Research: Design and Methods*. Los Angeles: SAGE Publications, Inc.

Zimmerman, E. 2004. Manifesto for a Ludic Century. In S. P. Walz & S. Deterding, eds. *The Gameful World: Approaches, Issues and Applications*. Cambridge: The MIT Press:19–22.

Zuckerman, M., Porac, J., Lathin, D. & Deci, E.L. 1978. On the Importance of Self-Determination for Intrinsically-Motivated Behavior. *Personality and Social Psychology Bulletin.* 4(3):443–446.

Appendices

6.7 Appendix A – Questionnaire

IMY 110 Questionnaire - Design website

Study title: Improving intrinsic motivation in tertiary education through gameful design.
Researcher: Annique Smith, (012) 420-4681
Supervisors: Mr JW De Beer; Professor TJD Bothma

This questionnaire will take about 20-40 minutes to complete. Please answer each question as truthfully as possible.
design.up.ac.za will hereafter be referred to as 'the website'.

EXPLANATION OF THE STUDY
This study has implemented a gamified system in the module of IMY 110 in order to determine whether the system improves the intrinsic motivation of the students.

Your involvement in this part of the study will consist of filling out a questionnaire.

The first part of the questionnaire was completed by the control group of this study and it will be used to gauge your intrinsic motivation in IMY 110. The second part will be used to find out about your use of the website that was implemented in the module in the first semester of 2017.

You will be completing the questionnaire anonymously. The data will be kept in a safe location and will not be used for purposes outside the study.

Your consent

1 . The nature, objective, possible safety and health implications have been explained to me and I understand them.

2 . I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication and/or conference presentations.

3. I understand that should I choose to stop participating in this project at any point, my questionnaire data will not be used and my questionnaire will be destroyed.

4 . Upon providing your consent, you may request a copy of this information.

1. I hereby voluntarily grant my permission for participation in the project as explained to me by Annique Elizabeth Smith. *

If you answer no below, your answers in the questionnaire will be deleted and excluded from the study.

- ◯ Yes
- ◯ No

Section 1: Your feelings towards IMY 110

The following section requires you to rate how you feel about IMY 110 and whether you enjoyed the subject.

2. Please rate your level of enjoyment in IMY 110. *

- ◯ I really enjoyed IMY 110
- ◯ I quite enjoyed IMY 110
- ◯ I found IMY 110 okay
- ◯ I did not enjoy IMY 110

3. Please provide a reason for your answer in the previous question. *

Your answer

4. Please rate the degree to which you found the content of IMY 110 interesting. *

- ◯ I found the content extremely interesting
- ◯ I found the content reasonably interesting
- ◯ I found the content okay
- ◯ I did not find the content interesting

5. Please provide a reason for your answer in the previous question. *

Your answer

Section 2: Perceived Competence

The following section requires you to gauge your feelings of competence for IMY 110.

6. Please respond to each of the following items in terms of how true it is for you with respect to your learning in this course. *

	1 - Not true at all	2	3	4 - Somewhat true	5	6	7 - Very true
I felt confident in my ability to learn the course material	○	○	○	○	○	○	○
I was capable of learning the material in the course	○	○	○	○	○	○	○
I felt like I was able to achieve my goals in the course	○	○	○	○	○	○	○
I felt able to meet the challenge of performing well in the course.	○	○	○	○	○	○	○

Section 3: The amount of effort you applied to IMY 110

The following section requires you to specify how much effort you feel you put into IMY 110.

7. Rate the amount of effort that you feel you put into IMY 110 by supplying a number between 1 and 10 according to the scale below *

	1	2	3	4	5	6	7	8	9	10	
I put in the minimum amount of effort	○	○	○	○	○	○	○	○	○	○	I put in as much effort as I could

8. In each of the following statements, indicate to what extent each of the following statements corresponds to why you put in the amount of effort that you specified in the previous question. *

	1 - Does not correspond at all	2	3	4	5	6	7 - Corresponds exactly
Having a good education is something I believe is important.	○	○	○	○	○	○	○
Because I really enjoyed learning the content.	○	○	○	○	○	○	○
My parents wanted me to pass.	○	○	○	○	○	○	○

I would look bad among my peers if I didn't do well.	○	○	○	○	○	○	○
I felt like I was wasting my time in the subject.	○	○	○	○	○	○	○
It would help me in the rest of my degree.	○	○	○	○	○	○	○
I didn't understand why the subject was important to me.	○	○	○	○	○	○	○
I value hard work, so I try my best at everything I do.	○	○	○	○	○	○	○
When I do well in a subject, I feel important.	○	○	○	○	○	○	○
I found it satisfying to accomplish the activities in the module.	○	○	○	○	○	○	○

Because it was a compulsory subject.	○	○	○	○	○	○	○
Getting good marks would help me to get a better job later on.	○	○	○	○	○	○	○

Section 4: Reasons for Participation

The following section relates to your reasons for participating in IMY 110. Different people have different reasons for participating in class, and the purpose of the following questions is to determine how true each of the following reasons is for you.

There are three groups of items, and those in each group pertain to the sentence that begins that group. Please indicate how true each reason is for you by using the following scale:

9. I participated in the IMY 110 module because: *

	1 - Not true at all	2	3	4 - Somewhat true	5	6	7 - Very true
I felt like it was a good way to improve my skills and understanding of markup languages.	○	○	○	○	○	○	○
Others would think badly of me if I didn't participate.	○	○	○	○	○	○	○

Learning the content of IMY 110 is an important part of becoming a multimedia expert.	○	○	○	○	○	○	○
I would feel bad about myself if I didn't participate.	○	○	○	○	○	○	○

10. I followed the lecturer's suggestions and lessons for learning the markup languages because: *

	1 - Not true at all	2	3	4 - Somewhat true	5	6	7 - Very true
I would get a good mark if I did what she said.	○	○	○	○	○	○	○
I believed my lecturer's instructions would help me to use the languages effectively.	○	○	○	○	○	○	○
I wanted others to think that I was good at markup languages.	○	○	○	○	○	○	○

It was easier to do what I was told than to think about it.	○	○	○	○	○	○	○
It was important to me to do well.	○	○	○	○	○	○	○
I would probably feel guilty if I didn't follow the lecturer's suggestions.	○	○	○	○	○	○	○

11. The reason that I will continue to learn more about markup languages and website design is because: *

	1 - Not true at all	2	3	4 - Somewhat true	5	6	7 - Very true
It's exciting to try new ways to use the languages.	○	○	○	○	○	○	○
I would feel proud if I continue to improve at using the languages.	○	○	○	○	○	○	○

It's a challenge to use the languages.	○	○	○	○	○	○	○
It's interesting to use the languages to come up with creative solutions.	○	○	○	○	○	○	○

Section 5: Presentation of the content of IMY 110

The following section requires you consider how the module was presented, whether you enjoyed the presentation methods and what changes you would suggest. Please rate your agreement with the following statements.

12. I found the practicals interesting and engaging. *

- ○ Fully agree
- ○ Agree slightly
- ○ Disagree slightly
- ○ Fully disagree

13. Please provide a reason for your answer in the previous question. *

Your answer

14. I found the assignments interesting and engaging. *

- ○ Fully agree
- ○ Agree slightly
- ○ Disagree slightly
- ○ Fully disagree

15. Please provide a reason for your answer in the previous question. *

Your answer

16. I found the project interesting and engaging. *

- ○ Fully agree
- ○ Agree slightly
- ○ Disagree slightly
- ○ Fully disagree

17. Please provide a reason for your answer in the previous question. *

Your answer

Section 6: Additional time spent using the markup languages

The following section requires you to provide information on additional time that you spent using the languages (HTML, CSS, JS) that were taught in IMY 110.

This does not include the time that you spent working for the purpose of the module, but it does include time that you spent doing quests on the website.

18. During the course of IMY 110, did you spend any time using HTML or CSS in your free time (i.e. not for the purpose of passing the module)? *

- ○ Yes
- ○ No

19. If you answered yes in the previous question, please explain the reason for spending additional time using the languages.

Your answer

Section 7: Intrinsic motivation

Intrinsic motivation is the type of motivation that you have for an activity when you do it just for the fun of it, or because it interests you. There is no external reason for doing the activity.

The following section requires you to rate your intrinsic motivation with regards to IMY 110.

20. Do you feel like you were ever intrinsically motivated towards the content of IMY 110? For example, did you ever spend time using the markup languages simply because you enjoyed doing so? *

- ○ Yes
- ○ No

21. If you answered yes in the previous question, please estimate the how often during the module you were intrinsically motivated towards the content by supplying a number between 1 and 10 according to the scale below.

	1	2	3	4	5	6	7	8	9	10	
I was rarely intrinsically motivated	○	○	○	○	○	○	○	○	○	○	I was intrinsically motivated throughout the module

22. If you answered yes in the first question above, please specify when you felt intrinsically motivated towards the content.

Your answer

23. Please provide any suggestions that would have enabled the module to be more intrinsically motivating to you? (i.e. what would have encouraged you to explore the content of the module simply because it interested you?) *

Your answer

Section 8: How often did you use the website?

This section requires you to gauge how often you used the website.

24. On average, how often did you log into the website? *

- ○ More than once a day
- ○ Once a day
- ○ Only during practicals or to download/upload assignments

25. On average, how long would you say you spent on the site per visit? *

- ○ 5 - 10 mins
- ○ 11 - 20 mins
- ○ 21 - 30 mins
- ○ 31 mins - 1 hour
- ○ More than 1 hour

26. Did you log into the site more often than you usually log into ClickUP for other modules? *

- ◯ Yes
- ◯ No

27. If you answered 'yes' in the previous question, please explain why.

Your answer

28. Please rate each of the following statements according to how often you used the website. *

	Never	Rarely	Quite often	Very often
To check my marks and the latest announcements	◯	◯	◯	◯
To download class notes	◯	◯	◯	◯
To see if I had gained any new achievements	◯	◯	◯	◯
To see if my quests had been marked	◯	◯	◯	◯
To do quests	◯	◯	◯	◯
To use the map	◯	◯	◯	◯

To fight monsters on the map	○	○	○	○
To gain more AP	○	○	○	○
To use the forum	○	○	○	○
To view my profile or timeline	○	○	○	○
To browse the newsfeed	○	○	○	○
To see if I had enough AP to buy something	○	○	○	○
To challenge a friend	○	○	○	○
To see if I had unlocked a new section of Nathan's website	○	○	○	○
To customise my avatar	○	○	○	○

Section 9: Parts of the website

This section requires you to specify which parts of the website you used and why.

The Map/Play

29. How often did you use the map/explore section of the site? *

	1	2	3	4	
Never	○	○	○	○	Very often

30. Please give a reason for your answer in the previous question. *

Your answer

Quests

31. How often did you do a quest on the website? *

	1	2	3	4	
Never	○	○	○	○	Very often

32. Please give a reason for your answer in the previous question. *

Your answer

Monster Battles

33. How often did you fight a monster (do a quiz) on the website? *

	1	2	3	4	
Never	○	○	○	○	Very often

34. Please give a reason for your answer in the previous question. *

Your answer

Challenging friends

35. How often did you fight a challenge a friend on the website? *

	1	2	3	4	
Never	○	○	○	○	Very often

36. Please give a reason for your answer in the previous question. *

Your answer

Checking your progress with Nathan's website

Nathan was the character who needed help with the website

37. How often did you check your progress with Nathan's website (to see if you had unlocked a new section)? *

	1	2	3	4	
Never	○	○	○	○	Very often

38. Please give a reason for your answer in the previous question. *

Your answer

Section 10: Profile Page

This section covers the Profile page part of the website.

Title

39. Did you ever change your title on your profile? *

- ○ Yes, more than once
- ○ Yes, once
- ○ No

40. Please give a reason for your answer in the previous question. *

Your answer

Avatar

41. Did you ever customise your avatar or frame on your profile? *

- ○ Yes, often
- ○ Yes, a few times
- ○ Yes, once
- ○ No

42. Please give a reason for your answer in the previous question. *

Your answer

Achievements

43. Please explain how you felt about earning achievements on the website. *

Your answer

44. Did you ever update your achievement icons below your profile picture? *

- ◯ Yes, more than once
- ◯ Yes, once
- ◯ No
- ◯ I didn't unlock any achievements/achievement slots

Classmates' Profiles

45. Did you ever view the profiles of your classmates? *

- ◯ Yes
- ◯ No

46. Please give a reason for your answer in the previous question. *

Your answer

Section 11: Effect on you

This section asks for your opinion with regards to how the website affected you individually.

47. Did you ever feel pressured to do the optional things on the website such as the quests or monster battles? *

	1	2	3	4	
Never	○	○	○	○	Yes, often

48. If you would like to, please explain your answer in the previous question.

Your answer

49. Did the optional things that you did on the website make you feel more confident with the work in IMY 110? *

- ○ Yes, I felt much more confident with the work
- ○ Yes, a felt a little bit more confident with the work
- ○ No
- ○ I didn't do the optional things

50. If you would like to, please explain your answer in the previous question.

Your answer

Section 12: Effect on IMY 110

This section asks for your opinion with regards to the website's effect on the module.

51. Did the use of the website make IMY 110 more engaging for you? *

- ◯ Yes
- ◯ No

52. Please explain your answer in the previous question. *

Your answer

53. Did you prefer using the website over using ClickUP? *

- ◯ Yes
- ◯ No

54. Please explain your answer in the previous question. *

Your answer

Section 13: The effect on the work in IMY 110

This section asks for your opinion regarding the effect of the website on the work in IMY 110.

55. Did the use of the website make the work in IMY 110 easier to understand for you? *

- ○ Yes
- ○ No

56. Please explain your answer in the previous question. *

Your answer

57. Did the use of the website make you more excited about the work in IMY 110? *

- ○ Yes
- ○ No

58. Please explain your answer in the previous question. *

Your answer

59. Did the use of the website cause you to spend some of your free time using markup languages/designing websites?

- ○ Yes
- ○ No

60. Please explain your answer in the previous question. *

Your answer

Section 14: Intrinsic Motivation

Intrinsic motivation is the type of motivation that you have for an activity when you do it just for the fun of it, or because it interests you. There is no external reason for doing the activity.

61. Do you think the website made you intrinsically motivated towards the work in IMY 110? *

	1	2	3	4	5	6	7	8	9	10	
No, not at all	○	○	○	○	○	○	○	○	○	○	Yes, very much

62. If you would like to explain your answer in the previous question, please do so below.

Your answer

Section 15: Final thoughts

Please give your full opinion on the questions below.

63. What did you enjoy most about the website? *

Your answer

64. What did you enjoy least about the website? *

Your answer

65. Which parts of the website do you think could have been improved? *

Your answer

66. Any final comments?

Your answer

6.8 Appendix B – Focus group questions

Opening question

1. Tell us what you **enjoy** doing most outside of studying Multimedia.

Introductory question

2. Briefly explain **how you felt** about using the Design site this semester.

Transition questions

3. Briefly explain how you **used** the website – which parts did you use and which ones didn't you.
4. Did you **enjoy** using the website?
5. Did you feel like using it was your **own choice**?

Key questions

6. Explain your reasons for **using/or not using** the **optional** parts of the site.
7. Did doing the things on the website have **value** for you? Did you feel they were **beneficial**?
8. Would you say you felt **good or skilled** at doing the things on the website?

a. Which **parts** of the site in particular made you feel more confident?
b. Did you feel more **competent in your abilities** the more you used the website?

9. Can you explain how you think the extra features on the site affected the way you **experienced** the **module and the work** in it?
10. How did the website affect how much you used HTML and CSS **outside the module**?
11. Did the website make you feel like you were a part of a **community** built around IMY 110? Did you feel part of something bigger than yourself?

Transition question

12. What did you think of the including some website stuff in the **classes**? Like the awards and winners.

Key questions

13. Do you think it would work to **include more things** from the website in the class in the future?
14. Do you have any **recommendations** for how the website could be improved or what could be added?
15. In the questionnaires people mentioned not using the challenge section because they don't like being in competition with others. What do you think of this?

Ending questions

16. Overall, do you think the website was a **good addition** to the module? Explain.

[Summary of what was said]

17. Did I mention everything that was said here? Is there anything you would like to add?

6.9 *Appendix C – Informed consent form for focus groups*

Statement of Informed Consent

Explanation of study

This study has implemented a gamified system in the module of IMY 110 in order to determine whether the system improves the intrinsic motivation of the students.

Your involvement in this part of the study will consist of taking part in a 1 hour focus group that will be used to determine your feelings about the system and your use of it.

You not will be required to share your surname in the focus group. The focus group session will be recorded using audio recording software on the researcher's mobile phone.

The data from this session will be kept in a safe location and will not be used for purposes outside the study.

1 Title of research project: **Improving intrinsic motivation in tertiary education through gameful design.**

2 I ..... hereby voluntarily grant my permission for participation in the project as explained to me by **Annique Elizabeth Smith.**

3 The nature, objective, possible safety and health implications have been explained to me and I understand them.

4 I understand my right to choose whether to participate in the project and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

5 I understand that should I choose to stop participating in this project at any point, my input in the focus group will not be used in the study.

6 I understand that my surname will not be asked during the focus group session to ensure confidentiality.

7 Upon signature of this form, you may request a copy.

Please confirm your consent to participate in this focus group and your consent for this session to be recorded using audio software.

☐ I want to participate

☐ I consent to the session being recorded using audio recording software

Signed: _____ Date: _____

Researcher: _____ Date: _____

6.10 Appendix D – Ethics approval for data collection

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

**Faculty of Engineering,
Built Environment and Information Technology**

1956 – 2016
60
years of
Engineering Education

Reference number: EBIT/72/2016 19 October 2016

Mrs AE Smith
Department of Information Science
University of Pretoria
Pretoria
0028

Dear Mrs Smith,

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

1. This means that the research project entitled "Improving intrinsic motivation in tertiary education through gameful design" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

   Conditions

   a) The researcher indicates in section 4.6 that students who participate will be given a one week extension for their module (IMY120). This kind of remuneration is not appropriate, because it coerces participation. This reward should be removed.

2. This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Ethics Committee.

3. If action is taken beyond the approved application, approval is withdrawn automatically.

4. According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

5. The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof JJ Hanekom
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY