Achievement Unlocked:
Investigating the Design of Effective Gamification Experiences for Mobile Applications and Devices

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BIT (Hons 1) & BCI Comm. Design

Submitted in fulfilment of the requirements
for the degree of Doctor of Philosophy

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2015

ABSTRACT

Using fun and games to motivate and engage people has had a long history. However, more recently designers have begun to directly translate elements from video games to non-game contexts in order to create more motivating and engaging experiences. The term *gamification* has been coined to describe this design strategy, and in the last five years a large industry has grown around providing gamification services. While research has demonstrated that gamification can be effective at producing behaviour change in various contexts, studies have found that it may also negatively affect the user experience. Further research is needed that investigates the impact that gamification has, not only on motivation and behaviour change, but on the user experience more broadly. Additionally, further strategies for designing gamification are needed. This thesis investigates these areas in order to contribute to a better understanding of the applicability, usefulness and effectiveness of gamification as a design strategy for engagement.

The original contribution to knowledge of this thesis is a novel framework for designing gamification, derived from an iterative process of evaluation. The thesis begins with the proposal of an initial framework, grounded in literature and used as a basis for the design of a gamification experience for university orientation. The gamification aimed to encourage new students to engage with an orientation event run by a university. A field study was used to evaluate the effectiveness of the gamification. The results of the study suggest that although the achievements were generally well-received by participants, there was little effect on experience and perceived motivation. The study also highlighted a number of design issues unique to gamification designs. These findings were used to expand and update the framework.

The updated gamification design framework was then used to design a gamification experience for people learning to drive. The gamification design aimed to encourage learner drivers to undertake diverse practice. A field study was used to evaluate the effectiveness of the gamification. The results of the study suggest that the gamification had some effect on behaviour change, was well-received, increased enjoy-

ment and had a significant effect on reported motivation. There were only a few minor design issues reported. These findings help justify the use of the proposed framework for gamification design.

As gamification becomes a more popular design technique in both research and industry settings, it is important to investigate effectiveness of the approach. The findings of this thesis contribute to this area, presenting a design framework to aid in the effective design of gamification. Ultimately this thesis contributes to a better understanding of the design and impact of gamification in today's society and how gamification can be used to affect our daily lives.

In every job that must be done, there is an element of fun. You find the fun, and - SNAP - the job's a game!

– Mary Poppins, 1964

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KEYWORDS

Gamification, gameful design, human-computer interaction, mobile, persuasive, pervasive, smartphone, usability, user experience, computer games, video games.

PUBLICATIONS

The following publications are based on key results from this research:

- **Fitz-Walter, Z.,** Wyeth, P., Tjondronegoro, D., & Johnson, D. (2014). *The Effect of Achievements on Students Attending University Orientation*. In the proceedings of the 1st Annual Symposium on Computer-Human Interaction in Play. ACM.
- **Fitz-Walter, Z**., Wyeth, P., Tjondronegoro, D., & Scott-Parker, B. (2013). *Driven to drive: Designing gamification for a learner logbook smartphone application.* In the proceedings of the 1st Gamification conference.
- **Fitz-Walter, Z**., Tjondronegoro, D. & Wyeth, P. (2013). *Gamifying everyday activities using mobile sensing.* In Tools for Mobile Multimedia Programming and Development. IGI Global.
- **Fitz-Walter, Z**., Tjondronegoro, D. & Wyeth, P. (2012). *A Gamified Mobile Application for Engaging New Students at University Orientation.* In the proceedings of the 24th Annual Conference of the Australian Computer-Human Interaction Special Interest Group (CHISIG) of the Human Factors and Ergonomics Society of Australia (HFESA).
- **Fitz-Walter, Z.**, Tjondronegoro, D. & Wyeth, P. (2012). *Encouraging Learners to Drive Using Game Elements and Smartphones.* As part of the Play in Unconventional Spaces Workshop in the OzCHI 2012 Workshops Programme.
- **Fitz-Walter, Z.**, Tjondronegoro, D. & Wyeth, P. (2011). *Orientation Passport: Using gamification to engage university students.* In the proceedings of the 23rd Annual Conference of the Australian Computer-Human Interaction Special Interest Group (CHISIG) of the Human Factors and Ergonomics Society of Australia (HFESA).
- **Fitz-Walter, Z.**, & Tjondronegoro, D. (2011). *Exploring the opportunities and challenges of using mobile sensing for gamification and achievements.* As part of the Mobile Sensing workshop in the proceedings of Ubicomp 2011.

ACKNOWLEDGEMENTS

What a journey. It is interesting to note that when I began this research investigation the word *gamification* did not really exist yet in academia. At the time I was situating my work as *persuasive, pervasive games* research – try saying that 10 times fast! However, for better or worse the term gamification has now become mainstream, and although there are still debates over its definition and use, a significant industry has been built around developing and deploying gamified systems. This PHD signifies a journey into the world of gamification, exploring what makes an effective gamification design in an attempt to contribute to the growing area.

Of course a PhD is never a solo effort and there are many people I need to thank for their help and support along the way. First, acknowledgements must be given to Jennifer Beale for providing thesis editing. Next to the Mobile Innovation Lab team and to the Games Research and Interaction Design Lab team at QUT. I've felt at home in both labs and have had a lot of support from the researchers and students in each lab, in particular Wei Song and Andy Lau. I need to thank Daniel Johnson who took on the role of an unofficial third supervisor, providing support and feedback over the course of the PhD. Next to my supervisors Dian Tjondronegoro and Peta Wyeth, who encouraged a research investigation into such a new area and provided support throughout the entire process. I need to acknowledge the social support of my friends, Samuel Jones, Zoe Chetwynd, and Edward Holland over the course of the PhD, also to the ongoing personal support from my close family, Teresa, John, Celia, and Harry and my partner's family, Anne, John, and Sean. To Jimmy Ti and Tony Wang, two of my best friends who without their incredible support, the PhD would have been very difficult to complete.

And finally, and most importantly, to Kiri Patton, who has been with me for the entire journey, seen me at my best and worst, and provided me with endless support throughout it.

STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _____

Date: _____

1. INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

In the field of Human-Computer Interaction (HCI) there is more to designing an effective system than just making is usable. A deciding factor for the success of a product is based on a user's experience with the product. People are more likely to invest their time, effort and money into a system based on how it makes them feel. Therefore, aspects such as enjoyment, motivation, and fun have become important design goals for computer systems (Rogers, Sharp, & Preece, 2011). Although designers can address these goals in various ways, one strategy that has gained popularity in recent years has become known as *gamification*.

Gamification, or gameful design, is a design strategy where game elements are used in non-game systems to promote behaviour change and hedonistic qualities of user experience. The primary drive is that if video games can create such engaging experiences, then other systems can adopt similar design elements and techniques to engage users as well. A game design element in this sense could include anything from game aesthetics, such as graphics and progress bars, to complete games with rules, story, levels, quests, achievements, and overarching goals (Deterding, Dixon, Khaled, & Nacke, 2011).

Although the area of gamification research is relatively new, research investigating the use of video game design elements in non-game contexts dates back to as early as the 1980s. The design and effect of game elements added to educational software was investigated during this time (Malone, 1981) and it was also proposed that fun should be considered a part of software design (Carroll & Thomas, 1988; Draper, 1999). The role of play in user experience design was subsequently further considered with the proposition of concepts such as *Funology* (Blythe, Overbeeke, Monk, & Wright, 2004; Monk, Hassenzahl, Blythe, & Wright, 2002) and *Playful Experiences* (Arrasvuori, Korhonen, & Väänänen-Vainio-Mattila, 2010; Korhonen, Montola, & Arrasvuori, 2009).

Many industry applications can now be found that use elements directly translated from video games (e.g., foursquare used points, badges and leaderboards in early versions of their mobile application). The term gamification was coined to help explain this concept. A number of researchers have focused on defining the term academically (Deterding, Dixon, Khaled, & Nacke, 2011; Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Huotari & Hamari, 2012). Other research has been undertaken to explore the use of game elements in a range of different contexts, including health (Chiu et al., 2009; de Oliveira, Cherubini, & Oliver, 2010; Fujiki et al., 2007), education (Mieure, 2012), green living (Gustafsson, Katzeff, & Bång, 2009), social and online communities (Montola, Nummenmaa, Lucero, Boberg, & Korhonen, 2009a; Vassileva, 2012) and utility software (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011).

A popular construct investigated by empirical gamification studies has been behaviour change. Results from these studies have generally indicated that adding game elements can lead to a change in behaviour (e.g., Cafazzo, Casselman, Hamming, Katzman, & Palmert, 2012; Chiu et al., 2009; de Oliveira et al., 2010; Farzan et al., 2008; Flatla et al., 2011; Froehlich et al., 2009; Fujiki et al., 2008; Gustafsson et al., 2009; Landers & Callan, 2011; Liu, Alexandrova, & Nakajima, 2011; Thom, Millen, & DiMicco, 2012). It appears that gamification is a useful design strategy for motivating users. However, motivation is only one part of a user's experience. Most software applications also have usability goals, such as efficiency, learnability, good utility, and ease of use. Other hedonistic user experience goals exist as well, such as entertainment, fun, and emotional fulfilment (Rogers et al., 2011). But only a few studies have explored the effect of gamification on these other goals.

The results of some studies have found that using gamification can lead not only to usability issues and confused users, but also to activities that are often associated with games and play-like behaviour, such as cheating. This suggests that although gamification may be able to change behaviour, further consideration of the design of gamified systems is needed, to make sure that these systems do not have other negative

consequences. Unfortunately, few gamification design guidelines currently exist to aid in the design process. Of those that do, results of their use is mixed. Some of these guidelines have not been evaluated (e.g., Kroeze & Olivier, 2012; Nicholson, 2012), some have produced systems with mixed results (e.g., Liu et al., 2011) and some focus narrowly on just one game element (e.g., Montola et al., 2009). Further research is needed in order to contribute to bridging this gap by providing evaluated guidelines to aid in the general design of effective gamification.

1.2 RESEARCH PROBLEM

As software design continues to mature software designers, developers and researchers have continued to investigate new ways in which to engage users. Gamification has been proposed as one possible way and previous research has found that adding game design elements to non-game contexts may encourage desired user behaviour. Although behaviour change is important, it is also imperative to look at the effect of gamification on other parts of the experience as well. Doing so can lead us to a better understanding of how to design effective gamified applications. More importantly it can help us to decide if gamification is a useful design strategy to engage users.

However, designing gamification can be a challenge as it is a subjective activity that depends on the target user, the context and the technology. Traditional design techniques and processes may be useful, but may not completely address some of the issues arising from the addition of game elements to non-game contexts. This research contributes to a better understanding of what makes an effective gamification design and how to design one, specifically focusing on mobile applications. Therefore, the question driving this research was:

How can an effective gamified system be designed for mobile applications?

To answer this research question, effective gamification design was investigated and a process for the design of effective gamification was be proposed in the form of a *gamification design framework.*

This research defines *effective gamification* in terms of three aspects: user experience, behaviour change, and player experience. If a gamification design manages to be usable, to change behaviour, and to create an enjoyable player experience then it has succeeded at being an effective design in terms of this research. Therefore, the following three constructs were proposed to evaluate a gamification design created using the gamification design framework:

- User Experience (e.g., usefulness, ease of use, control, enjoyment and motivation)
- Motivation (e.g., perceived motivation and actual behaviour change)
- Gamification Experience (e.g., enjoyment, suitable goals, engagement, cheating and dangers)

Based on these constructs, three propositions were formed as the basis for the evaluation:

1. Using the gamification design framework will result in a gamification design that is just as usable as a non-gamified version.
2. Using the gamification design framework will result in a gamification design that motivates the user more than a non-gamified version does.
3. Using the gamification design framework will result in a positive gamification experience for the user.

Additional sub-questions that this research also investigated included:

- What are some of the potential negative effects or unintended consequences that occur when game elements are added to non-game contexts?
- Which elements are required in a gamification design framework in order to guide effective gamification design?
- Is gamification a viable strategy for promoting engagement?

1.3 RESEARCH AIM AND OBJECTIVES

This study investigated the effective design of gamification. The following research objectives were identified:

- Explore the design and effect of gamification implementations in previous research
- Propose a gamification design framework
- Use the framework to develop gamification for smartphone applications that promote behaviour change
- Evaluate the framework by testing the effectiveness of the gamification implementations
- Improve the framework based on the findings of the evaluation

A literature review was first undertaken that critically assessed previous gamification designs and implementations. Based on the findings, a gamification design framework was proposed. This framework was then used to develop a gamified application that aimed to engage new university students in their first week at university. A field study was undertaken to evaluate the effect of this gamification design.

From the findings of the study, the gamification design framework was updated. The updated framework was used to develop a second gamified application that aimed to engage learner drivers to undertake a diverse range of practice. This updated framework was evaluated through its application in a field study and minor improvements to the framework were proposed.

1.4 SCOPE

Addressing the proposed research aim and the objectives is a large undertaking. Therefore, the scope of the research was limited to focus on a specific technology platform – smartphones. This does potentially limit the ability to transfer the results of this research to other contexts and this is taken into consideration when interpreting and discussing the results. However, smartphone applications have nonetheless become very popular since the release of the iPhone in 2007. The sensing and

networking capabilities of these devices have the ability to support gamification experiences well. There have also been a number of very popular gamified smartphone applications released in the past, such as *foursquare* and *RunKeeper*. The researcher also has expertise in the area of designing and developing smartphone applications and thus, developed the gamified applications used for this research study.

Although limited to smartphone applications, this research is not limited to gamifying new applications only. The gamification design framework proposed can be used to integrate gamification into existing smartphone application as well. With some further work it also has the potential to be used to evaluate existing gamification implementations.

1.5 SIGNIFICANCE AND CONTRIBUTIONS

As gamification techniques become more popular, there is a need for research to explore whether it is a valid and viable design strategy. The original contribution to knowledge of this thesis is a novel framework to aid in the design of effective gamification. This framework has been developed through a number of situated implementations, and the effectiveness of the framework has been evaluated using two empirical field studies. The framework provides guidance for gamification designers, along with six heuristics that can be used to identify and address problems unique to gamification design.

In addition to receiving an Australian Postgraduate Award (APA) the PhD candidate also received a top-up scholarship funded by the Smart Services CRC. The research was aligned to the following topic of the Smart Services CRC: "Multi-Channel Content Delivery & Mobile Personalisation". Research in this thesis led to the development of two gamified smartphone applications. The first, an orientation event application for new students was used at the Queensland University of Technology orientation event for three years and is still in use. The second application developed was a gamified learner logbook application for learner drivers in Queensland, Australia.

1.6 THESIS OUTLINE

Chapter 2 presents a literature review of previous gamification research and the initial gamification design framework. It begins by defining gamification in terms of this research and then discusses the design and impact of previous gamification implementations in research. Design science research is discussed as a methodology for this research and an initial gamification design framework is presented as starting point.

Chapter 3 presents the research framework used for the research study. The stages of research are discussed in detail and the user study methodologies are outlined.

Chapter 4 demonstrates the use of the initial gamification design framework to design a gamification application for new students attending university orientation.

Chapter 5 provides the results of a field study that evaluates the effectiveness of the orientation gamification design and initial framework.

Chapter 6 presents an updated version of the gamification design framework, based on findings from the evaluation study and on additional research into motivation.

Chapter 7 explains the use of the updated gamification design framework to design a gamification application for learner drivers undertaking mandatory practice.

Chapter 8 provides the results of a second field study that evaluates the effectiveness of the logbook gamification design and the updated framework.

Chapter 9 summarises the research investigation, contributions, limitations, and future work. Following this chapter is a list of references and appendices.

2. LITERATURE REVIEW

This chapter provides a literature review related to understanding the design and effect of gamification. It begins by defining the term gamification in order to focus the scope of the research. The impact of previous empirical gamification research is then explored and discussed. The chapter then highlights gamification design strategies proposed, and used, in previous research. A summary of research gaps is presented and design science research is discussed as a way to undertake research to fill the gaps. Finally, an initial gamification design framework is then presented as starting point for the research.

2.1 DEFINING GAMIFICATION

There is currently no unanimous definition for gamification. In industry the term has been described as "integrating game dynamics into your site, service, community, content or campaign, in order to drive participation" (Bunchball, 2010) or as "the use of game thinking and game mechanics to engage users and solve problems" (Zichermann & Cunningham, 2011). Being market-driven, these definitions are either outcome focused or describe gamification as a tool for primarily engaging and motivating people.

In academia, Huotari and Hamari (2012) proposed a definition which "emphases the experiential nature of games and gamification, instead of the systemic understanding". Based on games and marketing literature, they define gamification as "a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation". Using Zichermann & Cunninghams's definition above (2011), Guin et al., (2012) also suggest a definition for gamification in market research where gamification "is the application of game mechanics (or game thinking) to an interaction with respondents, whether in a quantitative or qualitative setting".

These definitions above are useful but are focused on a particular context or outcome, or are broad in their definition and use terms that need further clarification – such as game thinking or dynamics.

Another definition by Deterding et al. (2011) is currently the most cited academic definition for gamification. In their paper the authors described gamification as "the use of game design elements in non-game contexts". Although broad, this definition was accompanied by additional discussion that defined game elements and discussed that they could be anything from game aesthetics, such as graphics and progress bars, to complete games with overarching goals, rules, story, levels, quests and achievements. This definition aimed at separating the term gamification from *toys*, *playful design* and *serious games* along two dimensions. One dimension distinguished between *play* and *games*; the other distinguished between a *complete game* and an *artifact with game elements*. This dimensional approach could is useful for providing a way to identify gamification-related research published before the term gamification was coined. An additional dimension could also be considered that distinguishes between pervasive gaming and simulations, to further aid in identifying gamified systems. How these dimensions relate to gamification is important to explore further in order to arrive at a definition suitable for this research.

2.1.1 GAMIFICATION COMPARED TO PLAYFUL DESIGN

Forms of play have been placed on a continuum by Caillois (1961) from ludus to paidia, where ludus describes structured activities with explicit rules (games) and paidia describes unstructured and spontaneous activities (playfulness). Deterding et al. (2011) propose that the concept of gamification relates more closely to ludus than to paidia. This separates gamification from *playful design* – the design for playfulness and fun in computer systems (Gaver et al., 2004; Korhonen et al., 2009). Playful design generally aims to elicit playful experiences when designing utilitarian products. Take for example the piano stairs project from The Fun Theory (Volkswagen, 2010) whereby a public staircase was transformed into an interactive piano that encouraged pedestrians to walk up the stairs instead of taking the adjoining escalator. The idea behind the piano stairs was to use fun to encourage exercise. The stairs are de-

signed to be playful, encouraging unstructured and spontaneous activity. There are no specific goals or rules provided to users that explain how the stairs can be used.

Gamification on the other hand more closely represents structured activities with explicit rules. Because of this, gamification has also been called *gameful design* (Deterding et al., 2011), separating it from the concept of playful design. However, this does not mean that a gamified application cannot elicit playful behaviours and mindsets (Deterding et al., 2011).

2.1.2 GAMIFICATION COMPARED TO COMPLETE GAMES

Rather than being a complete game, a gamified service can be seen as an artifact that includes game elements (Deterding et al., 2011). A utilitarian application can be considered gamified if a designer adds game elements to it, such as game aesthetics, progress bars, quests, or achievements. However, the boundary between a gamified application and a complete game is blurry (Deterding et al., 2011). Although not a complete game, a user could still potentially interpret it like a game and play it as if it were a game. This creates an interesting duality that needs to be considered.

2.1.3 THE DUALITY OF GAMIFIED APPLICATIONS

When a designer adds game design elements to a non-game application, the application has the potential to be used like a tool *and* a game. Malone (1981) proposed that computer systems could be divided into two categories, tools and toys. Malone (1981) explains that a tool is a system used to achieve an external goal, such as a text editor. Whereas, a toy is a system used for its own sake with no external goal, such as a computer game. Although both systems are designed for different purposes, Malone proposed that in cases where the external goal of a tool is not highly motivating (e.g., is routine and boring), toy-like features could be useful in making the activity enjoyable. The idea behind this can be seen as an attempt to harness the engaging aspects of games and use them to frame less motivating, non-game activities as game-like, to

make them more engaging. This can be seen as an early example of gamification. However, this means that a tool using game elements could also be potentially *played* like a game. For example, a user who checks in to a location in foursquare may be doing so to share their location with their friends – an external goal. Another user may check in to a location in order to receive points to increase their weekly score – a game goal. Another user might check in for both reasons simultaneously. In this way, by adding game design elements to a non-game application, the application could be used as both a tool and game. How these two sides co-exist and support each other is an important consideration in gamification design.

2.1.4 GAMIFICATION COMPARED TO SERIOUS GAMES

A serious game is a game where the primary goal is to educate, rather than just to entertain players (Michael & Chen, 2006). Gamified applications are similar to serious games in the way that they have an underlying serious goal, which is often related to behaviour change. Unlike serious games, which are complete games in themselves (Deterding et al., 2011), gamified applications "merely incorporate elements of games". But again, the boundary between complete game and adding game elements is blurry.

2.1.5 GAMIFICATION COMPARED TO PERVASIVE GAMES

Pervasive games are games that consciously blur and break the traditional boundaries of a game. The *magic circle* is a term used to define a separated space in which most games take place. In this space players operate within a unique set of rules and constructs as defined by the game (Huizinga, 1950). However, a pervasive game will expand this contractual magic circle spatially, temporally, or socially (Montola, 2005). Where traditional games are often confined to a distinct play area, a pervasive game can span multiple environments, encompass real people as players (sometimes involuntary), and may be played at any time (Montola, 2005). Pervasive games have also been explored as tools of persuasion, with research producing games such as *Savannah,* which teaches children how lions hunt using mobile devices (Benford et al., 2004 and Benford et al., 2005), *Power Agent (*Gustafsson et al., 2009; Bang

et al., 2009), a game that explores reducing household energy consumption, and *Time to Eat* (Pollak et al., 2010), which encourages healthy eating.

Gamified applications can be seen as having similar qualities to pervasive games, where adding game elements to non-game contexts has the ability to create a game-like experience. Being attached to a real activity, the game experience may expand the magic circle spatially, temporally, or socially. For example, giving points for checking in to a foursquare location can create a game that may happen anywhere, at anytime and with anyone. The only difference is that pervasive games are generally complete, whereas gamified applications are not complete games. Here again, the boundaries between a pervasive, serious game, and gamified application are blurry.

2.1.6 A DEFINITION OF GAMIFICATION FOR THIS RESEARCH

This research uses the definition from Deterding et al. (2011) as a base, and defines gamification in the context of HCI as **a design strategy where game elements are used in non-game applications to promote behaviour change and enhance the hedonistic qualities of the user experience**.

In addition to this definition, the following qualities of gamification are proposed, where a gamified application is:

- **…more gameful than playful,** as it deals specifically with more structured, rule-based play, and is therefore gameful design. Note that a gamified artifact can still encourage playful behaviour.
- **…not a complete game,** in the sense that it is primarily a system with game elements added to it. However, it could still be played and interpreted as a game.
- **…both a tool and game,** where users might be motivated to use the system for an external goal, a game goal, or for both goals simultaneously.

- **…not primarily for entertainment,** but rather with a more serious agenda for a range of different uses, such as behaviour change or enhancing the user experience.
- **…not a pervasive game,** but has pervasive qualities, allowing it to expand the magic circle either spatially, temporally or socially.

Gamification research that predates the term gamification can be identified using these qualities. For example, the term gamification was not used in the article describing the medication alarm system *Movipill* (de Oliveira et al., 2010). However, the article nonetheless describes a gamified system where points and a leaderboard (game elements) are added to a medication reminder system (non-game context) to encourage users to take their medication on time (behaviour change). The system is primarily a medication reminder tool and not a complete game. It has pervasive qualities as it is embedded into a medication schedule. It is not primarily for entertainment but rather has a serious agenda of encouraging medication compliance. According to the definition and qualities proposed above, this tool is an example of gamification.

2.2 THE IMPACT OF GAMIFICATION

A number of empirical gamification studies were found using the definition and qualities proposed in the previous section. Popular research constructs were identified, along with evaluation techniques, influences of gamification, and any issues that arose as a result of the application of gamification.

2.2.1 CONSTRUCTS INVESTIGATED BY PREVIOUS RESEARCH

A popular construct investigated by empirical gamification studies has been behaviour change (e.g., Chiu et al., 2009; de Oliveira et al., 2010; Fujiki et al., 2008; Landers & Callan, 2011; Li, Grossman, & Fitzmaurice, 2012). Behaviour change has often been measured by recording a participant's time and frequency spent on a gamified activity. This usage data is generally automatically obtained by the gamified system using various sensors. For example, Chiu et al. (2009) created a system that recorded daily intake of water, and De Oliveria et al. (2010) created a

system that automatically recorded when medication was taken. Gamified usage data was often compared with usage data from either a pretest or a control group (e.g., Flatla et al., 2011; Liu et al., 2011; Pollak et al., 2010). Other measures, such as surveys, diaries, and interviews, were used to evaluate more subjective constructs such as motivation (e.g., Grimes, Kantroo, & Grinter, 2010). In addition to behaviour change and motivation, some of the evaluations also investigated user experience constructs, including enjoyment (e.g., Flatla et al., 2011; Li et al., 2012) and user satisfaction (e.g., Cafazzo et al., 2012; Montola, Nummenmaa, Lucero, Boberg, & Korhonen, 2009b). These subjective constructs were often measured using surveys and interviews.

2.2.2 PREVIOUS GAMIFICATION EVALUATION TECHNIQUES

Many previous studies used field studies to evaluate the effect of gamification, but beyond that there was little consistency between evaluation techniques. These studies varied greatly in terms of study contexts, measures, length, and participants. The most common scientific method of evaluation employed was the field study (e.g., Chiu et al., 2009; Grimes et al., 2010; Liu et al., 2011; Singer & Schneider, 2012; Cafazzo et al., 2012; Kuntz et al., 2012). Laboratory experiments were also used to evaluate the impact of gamification in some cases (e.g., Flatla et al., 2011; Li et al., 2012).

Previous evaluations often studied the effect of just one intervention (e.g., Grimes, Kantroo, & Grinter, 2010b; Gustafsson et al., 2009; Landers & Callan, 2011; Montola et al., 2009b; Xu et al., 2012). A number of other evaluations compared the intervention to a control, or to different versions of the intervention (e.g., Chiu et al., 2009; de Oliveira et al., 2010; Froehlich et al., 2009; Liu et al., 2011). Of these, some evaluations used independent measures and some repeated measures.

The length of the evaluations and number of participants involved varied depending on the context and domain of the gamified intervention. For example, an experiment investigating a gamified survey lasted the time it took to fill out the survey (Guin et al., 2012), whereas gamifica-

tion implemented on a social network was studied for over six months (Thom et al., 2012). The number of participants who took part in the evaluations ranged from four (Fujiki et al., 2007) to 3486 participants (Thom et al., 2012).

Data collected during experiments primarily included usage data, interview notes, and survey responses. It was also common for mixed-methods research to occur (e.g., Flatla et al., 2011). Interviews and surveys were often administered to gather explanatory qualitative data or subjective user experience data, such as feedback on user enjoyment or fun. There were very few common research tools or measures used across the studies. Administered surveys often asked a list of questions that the researchers had formulated, or adapted questions from surveys used to evaluate non-gamified software.

2.2.3 THE EFFECT OF GAMIFICATION ON BEHAVIOUR

As gamification started to gain momentum as an industry solution for engagement, a common theory held by practitioners was that the addition of reward- and competitive-based game elements, notably of points, badges, or leaderboards, would result in behaviour change and increased enjoyment in non-game contexts (Bunchball, 2010; Zichermann & Cunningham, 2011). In research however, evaluations of gamified systems have revealed mixed findings. A number of studies have reported that the addition of game elements led to a change of behaviour during the study (Cafazzo et al., 2012; Chiu et al., 2009; de Oliveira et al., 2010; Farzan et al., 2008; Flatla et al., 2011; Froehlich et al., 2009; Fujiki et al., 2008; Gustafsson et al., 2009; Landers & Callan, 2011; Liu et al., 2011; Thom et al., 2012). Thom et al. (2012) also reported a significant decrease in user contributions after gamification was removed from an enterprise social network system, indicating gamification had a desirable effect on behaviour. Farzan et al. (2008) found that adding points, levels, and leaderboards to an enterprise social network led to an immediate increase in contributions but then motivation to contribute declined shortly afterwards. Interestingly, Xu et al. (2012) also found that over time there was a reduced effectiveness of their health game intervention. This suggests that engagement with certain gamification designs may wane over time.

Previous research has also found that adding game elements to non-game contexts affected various user groups differently, particularly relating to user gender and age. For example, Malone (1981) found that there was a significant difference between genders regarding what boys and girls liked about game elements added to a mathematics application. Another application called *Chick Clique* aimed to encourage girls to undertake more physical exercise by rewarding them for the number of steps walked each day (Toscos, Faber, An, & Gandhi, 2006). Results from a small field trial suggested that the design influenced older girls more than it did younger girls, but this could have been due to external factors such as sports training.

Other research found that different user groups emerged based on their experience with game elements. For example, three different groups of users formed after an achievement system was added to the *Nokia Image Space* application (Montola et al., 2009). These groups included "indifferent users" who felt that the achievements were nice, but not personally motivating, "appreciative users" who liked the competition and comparison with other users, and "confused users" who did not understand the purpose of the achievements and thus disliked them. This suggests that different gamification elements and designs may appeal to different types of people, which is similar many video games where different types of games can appeal to different demographics of players (Schell, 2008).

2.2.4 GAMIFICATION CAN LEAD TO NEGATIVE EFFECTS

Some previous studies recorded negative effects from gamification. Montola et al. (2009) studied the effect of achievements on user experience and found that some users did not appreciate the added game elements, saying that they were distracting, confusing and unnecessary. Guin et al., (2012) revealed that adding a fantasy roleplaying game to a market research survey led to a low completion rate of 58% compared to three other non-gamified surveys with completion rates of around 94%. The authors noted that usability issues may have led to this lower rate because the gamified survey could take up to 2 minutes to load on

some internet connections. It is likely that users became impatient and left before they even started the survey.

Singer and Schneider (2012) reported that game elements added to version control software encouraged one user to try to cheat the system for extra points. In the same study participants discussed the competitive nature of the leaderboard, indicating that the added competition may have been effective, but was not entirely comfortable for them in the context. Toscos et al. (2006) summarised that users of their exercise system were concerned that the added competitive game elements could lead to excessive exercise. Fröehlich et al. (2009) reported that participants considered opportunities to cheat their system. Xu et al. (2012) found that some users of their health game intervention became focused on winning, and rivalries formed between schools. One student even admitted to finding and keeping a pedometer from another school until game ended, just to disadvantage the other school. This suggests that adding game elements has the potential to create a number of unique problems that may be overlooked during design.

2.2.5 EVALUATING THE IMPACT OF GAMIFICATION

It can be seen that the impact of previous gamification research has been mixed. Although there is generally an increase in desired behaviour, this can sometimes be short-lived. It also appears that different designs have the potential to appeal to different users groups based on aspects such as age, gender and game preferences. Conversely, there may also be negative effects on other constructs such as usability or player experience. It is likely that the effect of the gamification in each study was heavily influenced by a number of things, including the gamification design, the particular users, and also the context of use. Therefore, there is a need to investigate gamification design further, exploring what may contribute to a more effective design.

2.2.6 DEFINING EFFECTIVE GAMIFICATION

This research defines *effective gamification* in terms of four aspects: user experience, motivation, behaviour change, and gamification experience. The first is that the added gamification should not negatively affect the

user experience of the application, including both hedonistic and utilitarian qualities of the experience, for example, the addition of gamification to a survey (Guin et al., 2012) resulted in a lower completion rate than non-gamified surveys, potentially due to usability issues. The second aspect is that the resulting gamification design should result in the user feeling motivated. The third aspect highlights the effect on behaviour change, for example, encourage medication compliance (De Oliveria, 2010) or make calibration tasks more engaging (Flatla et al., 2011). The fourth aspect is that an effective design should result in a positive gamification experience. The user (as a player) should find the game-like experience fun, enjoyable and without play-breaking issues, such as cheating.

2.3 GAMIFICATION DESIGN

Gamification design has varied from study to study and continues to be a focus of ongoing research. Some studies have used user-centered design techniques, some have been inspired by video game design, and some have created their own gamification framework to aid design. A review of 32 peer-reviewed papers that presented gamification implementations found that a common theme of their designs was the use of competition and reward-based game elements such as points and leaderboards (e.g., de Oliveria et al., 2010) or achievements (e.g., Montola et al., 2009). Over the course of this research there has been parallel research undertaken by others that has focused in looking at the effect of these types of game elements. Some researchers (e.g., Nicholson, 2012) have argued that just using competition and reward-based game elements alone in gamification design is detrimental as it focuses on extrinsic motivation. Nicholson (2012) has proposed that gamification designs need to focus on creating more meaningful and intrinsically motivating experiences in order to be more effective.

2.3.1 GAME ELEMENTS USED IN GAMIFIED SYSTEMS

Gamification implementations in 32 peer-reviewed articles were reviewed. Based on the descriptions and images provided, twenty

different game design elements were identified as part of the gamified systems presented. These ranged from specific elements (e.g., points and leaderboards) to more abstract elements (e.g., curiosity and roleplaying). Some systems used more than one game design element. Extrinsic reward-based game elements have been popular elements used in previous gamification design for research. The top reoccurring game design element used in these systems was points (see Table 2.1).

Primary Game Elements Used	**Number of systems using element**
Points	13
Leaderboards	12
Game-like graphics	11
Levels/Rank	10
Competition	10
Avatars	9
Feedback/Rewards	4
Achievements/Badges	4
Virtual Currency	3
Teamwork	3
Mini-game	3
Challenge	3
Fantasy	3
Roleplaying	2
Quiz	2
Tangible rewards	2
Narrative	2
Virtual Pet	1
Goals	1
Experience points	1
Curiosity	1

Table 2.1 – Game design elements used in reviewed gamified systems

Apart from 'game-like graphics' listed in the table above, the top five elements are examples of reward- and competition-based game elements (Nicholson, 2012). This suggests that these game elements are a popular approach to gameful design, at least in this sample of implementations. As mentioned earlier, these reward- and competition-based

elements are also popular in early industry implementations of gamification (Bunchball, 2010; Zichermann & Cunningham, 2011). This would suggest that the theory, held by some, would be that the use of these particular game elements would result in positive behaviour change. However, as noted in section 2.2.3 and 2.2.4 the use of these elements may not always lead to positive behaviour change and may also lead to negative effects.

Of the 32 articles reviewed, only 14 provided some detail regarding the design of game elements. One system used four design principles as design inspiration: *simple*, *informative*, *discreet* and *motivating* (Fujiki et al., 2007, 2008; Kazakos, Bourlai, Fujiki, Levine, & Pavlidis, 2008). However, no details were provided showing how these principles were derived. Another study (Law et al., 2011) noted that their gamification design was based on the *foursquare blueprint*. Foursquare is a popular location-sharing social network application that previously used reward-based game elements to engage its users (primarily points, badges and leaderboards). The popularity of foursquare led to these game elements often being used as the basis for gamification design in other systems (e.g., Law et al., 2011). However, research that predates the release of foursquare can be found that uses reward-based game elements. For example, Farzan et al. (2008) drew from previous HCI, and motivational psychology research into incentives, to inform the design of a point-based incentive system for an enterprise social network. The design was aimed at rewarding user reputation in the social network and desirable site interactions were chosen by analysing previous website activity. Point values of varying amounts were then applied based on the importance of the activity being promoted.

2.3.2 GUIDELINES PROPOSED FOR GAMIFICATION DESIGN

Various guidelines have been presented in previous research to aid in the design of game elements for non-game contexts, with some being used to design and evaluate gamified systems. Malone (1981) proposed a set of heuristics for designing enjoyable user interfaces using game elements. These heuristics, based on the results of various empirical studies, were organised into three categories: *challenge*, *fantasy*, and

curiosity. Malone notes that these heuristics are meant as suggestions only, and not as requirements. Malone also notes that it is easy to use these elements badly. A number of other studies have recently used Malone's heuristics to integrate game elements into their own systems. For example Li, Grossman, & Fitzmaurice (2012) used these heuristics, along with a model of player enjoyment (Sweetser & Wyeth, 2005), to design game elements for a software tutorial system. Another study (Flatla et al., 2011) used Malone's heuristics as a base for their own design framework for making gamified system calibration tasks. This framework was based on linking calibration tasks that a user may undertake to related game mechanics. Using the mechanics identified, a game could then be created by using four basic elements of games derived from previous taxonomies of game elements – challenge, theme, reward and progress (Hunicke, LeBlanc, & Zubek, 2004; Malone, 1981). This framework was used to design and evaluate three different calibration games (Flatla et al., 2011). An evaluation was undertaken with 12 participants, with results suggesting that the calibration games were more enjoyable and did not compromise the quality of calibration data.

Montola et al. (2009) undertook research exploring the effect of an achievement system in a photo sharing application. To design the achievements they first reviewed five popular videogames that used achievement systems. Based on that review, they identified 14 different achievement categories, including *tutorial*, *completion*, *collection*, *paragon* and *fandom*. They proposed that adding achievements to non-game contexts could promote social status, the drive to complete everything, and extended playtime. These 14 categories were used as a basis to design and evaluate achievements added to a test version of the mobile photo sharing social network, *Nokia Image Space*. The purpose of the added achievements was to encourage users to add new content during the trial. The results of their evaluation proved to be mixed; some users appreciated the achievements, some did not, and some were indifferent.

The *Gamification Loop* was proposed by Liu, Alexandrova, & Nakajima (2011) to aid in gamification design. It identified the use of challenges, rewards, leaderboards, badges, social network and status – all centered around a point system. How the loop was devised was not explicitly

stated, but it seems to draw from reward-based gamification implementations often found in industry at the time, for example *Bunchball* and *Badgeville*. The loop was used to design two gamified experiences; however, an evaluation found that in both cases the gamification did not have a significant impact on motivation.

In order to steer away from this reward-based gamification design, Nicholson (2012b) proposed guidelines that involved supporting *meaningful gamification*. These guidelines outlined the following three strategies:

1. Focusing on play-based gamification elements.
2. Creating transformative opportunities through participatory activities.
3. Thinking in three dimensions to create a ludic learning space.

These guidelines offer an alternative approach to designing gamification that is based on Organismic Integration Theory (OIT), a sub-theory of Self-Determination Theory (SDT) proposed by Deci & Ryan (2002). Although examples of meaningful gamification are provided, a system could not be found that was built and evaluated using the guidelines, in the literature.

Another framework was proposed to aid in the design of gamified authentication systems based on research into authentication, serious games and persuasive games (Kroeze & Olivier, 2012). The framework focuses on both usability goals and game elements. The authors stressed the importance that the game should not affect the process of authentication and should also be usable. They identified three elements as being important in a usable authentication game:

1. Authentication qualities – where users are authenticated by any of three qualities; knowledge, ownership, inherence (knowledge is something they know e.g., a password).
2. Usability goals – where the added game should not affect effectiveness, efficiency, safety, utility, learnability, and memorability.

3. Game – where the added game has rules, players, struggle, and goals (Salen and Zimmerman, 2004).

A documented system could not be found in the literature that was built and evaluated using these guidelines.

These results suggest that gamification design is an area that is being investigated. Of the frameworks that have been used to design gamification, results have been mixed. Some have resulted in positive initial results in specific contexts (e.g., Flatla et al., 2011) while others have not (e.g., Liu et al., 2011). There exists a need for more general gamification design guidelines that have been evaluated for their effectiveness. It would be useful for these guidelines to draw upon previous successful guidelines such as those from Flatla et al. (2011) in order to create a more effective gamification design. Beyond creating specific guidelines for designing gamification, other studies have drawn from different research areas to inspire the design of their gamified systems. For example, Chiu et al. (2009) were inspired by persuasive technology strategies, and Landers & Callan (2011) looked at goal-setting theory from psychology. Other studies were influenced by game design, user-centered design, or they created their own guidelines for gamification design.

2.3.3 USING GAME DESIGN TO AID GAMIFICATION DESIGN

Game design theory, processes and techniques informed some gamification designs. As noted earlier both Malone (1981) and Montola et al. (2009) studied previous games in order to influence their design. Guin et al. (2012) refers to using books on game design (McGonigal, 2011; Schell, 2008) in order to aid in the design of game elements for an electronic survey. This study outlined and used five basic elements of a game as building blocks: incorporation of a backstory, a game-like aesthetic, rules for play and advancement, a challenge, and rewards. The results of a field study evaluation found that the gamified survey produced higher satisfaction scores, but did not result in an increase in engagement, potentially due to usability issues. Graf et al. (2006) proposed the notion of fun-patterns for supporting motivation in software

products. These fun-patterns, based on patterns found in game design, were drawn from a featured article on the Gamasutra website (Shelley, 2001). Li et al. (2012) chose game elements that they felt most appropriate for a tutorial system, based on previous game design research (Hunicke et al., 2004; Malone, 1981, 1982; Sweetser & Wyeth, 2005). The results of an evaluation of this design (Li et al., 2012) found that those who used the gamified system reported higher subjective engagement levels and performed a set of testing tasks faster with a higher completion ratio.

Although the studies above used game design as a basis, only one study gathered player feedback on the design of the gameplay experience (Gustafsson et al., 2009). This study focused on the evaluation of a system with game elements for domestic energy engagement among teenagers. A field study was used to evaluate the system, usage data was logged and interviews after the study undertaken. Results suggest that the game concept was motivating and engaging during the study; however, the study did not show any conclusive long-term effects after the trial was over. No other studies reported on evaluating the playability of the game elements before deploying the gamified system.

These results suggest that using game design and evaluation techniques may be useful to design a more satisfying and engaging gamification design. However, other aspects of the design still need additional consideration, including usability and support for motivation.

2.3.4 USING USER-CENTERED DESIGN TECHNIQUES TO AID GAMIFICATION DESIGN

In order to aid gamification design, some researchers employed user-centered design techniques and created prototypes iteratively throughout the design process. For example, *Chick Clique* was a tool to motivate teenage girls to exercise that was built by: consulting dieticians, iterating through low and hi-fidelity prototypes, and running usability studies (Toscos et al., 2006). A small field study of seven participants was undertaken, with the results of post-interviews with participants

suggesting that the interface was easy to use and participants liked the concept of the application.

Iterative, user-centered design was also used to design *UbiGreen*, a system for tracking and supporting green transportation habits (Froehlich et al., 2009). Prototypes were used to design the system, and prototype feedback was gathered from users via online questionnaires and used to improve the design. A field trial with 14 participants suggested the system valued the feedback it provided on their transportation choices and that the system had potential for behaviour change. However, issues arose around participants considering opportunities to cheat the system.

User-centered design techniques were also used to design a gamified mobile health application for managing adolescent type-1 diabetes (Cafazzo et al., 2012). Design requirements for the system were gathered by interviewing six adolescents and their parents. A pilot field trial with 20 participants (but only 12 sets of usable data) found that participant satisfaction with the system was high and that it increased the average number of daily measurements being undertaken. Pollak et al. (2010) extensively tested prototypes of a mobile game that promoted healthy eating before deploying it to the target demographic of middle-school students. Results of a field trial with 53 participants over four weeks indicate that those participants who played the game ate a healthier breakfast than those who did not. The design of a mobile health game for adults (Grimes et al., 2010b) was iterated extensively before arriving at the final prototype. It was improved using brainstorming and feedback sessions with HCI researches, game design experts, and a dietician. Results of a field trial with 12 participants over three weeks suggest that participants generally found the game fun and said it helped them learn about eating. Finally, paper and digital prototypes were used in another study (Law et al., 2011) to design a gamified mobile application that could capture road accident photos. However, no evaluation of the application was provided in the literature reviewed so it is difficult to determine its effectiveness.

These results suggest that using user-centered design techniques proves to be useful in the design process, in particular using iterative prototypes before deploying the gamified system. However, using user-centered design techniques alone may mean that certain issues related to the player experience are missed, such as issues related to cheating. Combining both game design and user-centered design techniques may create a more effective gamification design.

2.3.5 CONSULTING EXPERTS DURING THE DESIGN PROCESS

Some previous studies described how various experts were consulted during the design process. Grimes et al. (2010) consulted a dietician and also game design experts when designing their application, which led to a fun game. During the design of their *Chick Clique* application, Toscos et al. (2006) also consulted three dieticians. An expert evaluation was also undertaken by Montola et al. (2009) to categorise achievements from five games. Although expert consultation when designing behaviour change systems is often implied, these studies reinforce the importance of this activity during the design process.

2.4 IDENTIFYING A SUITABLE RESEARCH METHOD

Whilst there have been a few previous guidelines and frameworks proposed for gamification-related design, only a few have been used to create gamified applications and these applications have had varied success. The majority of the frameworks focus on designing for specific contexts (e.g., calibration tasks) rather than supporting more general gamification design. Therefore, in order to aid gamification design, there is a need for a more general, operationalised and evaluated framework to aid in creating effective gamification experiences.

2.4.1 ADOPTING DESIGN SCIENCE RESEARCH

Adopting a design science research (DSR) approach could provide a useful methodology for this research. DSR encompasses the study of artificial phenomena created by humans, as opposed to the study of natural phenomena (Hevner & Chatterjee, 2010; Hevner, March, Jinsoo,

& Ram, 2004). Where natural science is concerned with understanding the natural world, design science focuses on attempting to extend the boundaries of human and organisational capabilities by creating new and innovative artifacts. The design-science paradigm stems from engineering and the sciences of the artificial (Anderson, Reder, & Simon, 1996). It is fundamentally a problem-solving paradigm. It aims to create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, and use of information systems can be efficiently accomplished (Denning, 1997; Tsichritzis, 1997 via Hevner et al., 2004). DSR addresses organisational problems in unique or innovative ways, or solves them in more effective or efficient ways (Hevner & March, 2003).

2.4.2 DSR CONTRIBUTIONS

Gregor and Hevner (2013) propose that there are three design science research contribution types that emerge from DSR outputs. These range from more specific, limited and less mature knowledge to more abstract, complete and mature knowledge. The first contribution type is a situated implementation of an artifact. Examples for this level of contribution type include instantiations such as software products or implemented processes. In the case of this research, any gamified systems implemented using the gamification design framework falls under this contribution type. This contribution type is an example of more specific, limited, and less mature knowledge (Gregor and Hevner, 2013). The gamification design framework proposed in this research is an example of the second contribution type from DSR. This contribution type is nascent design theory, which is knowledge as operational principles or architecture. The third contribution type is well-developed design theory about embedded phenomena. Example artifacts of this contribution type include mid-range design theories and grand theories. A design theory based on the results of this research is proposed at the end of this thesis, for future investigation. These last two contribution types are more abstract, complete and mature knowledge.

2.4.3 DSR METHOD

DSR involves a loop of two primary activities: building and evaluating. Building consists of constructing an artifact that addresses a specific problem; evaluating consists of determining how well the artifact performs in accordance with an informing theory. This artifact could range from a construct, model, method, instantiation (Hevner et al., 2004), to design principles, technological rules (Gregor & Hevner, 2013), social innovations (Aken, 2004) or even new properties of technical, social or informational resources (Järvinen, 2007). The artifact is at the core of DSR, but what serves as the main contribution of this research is the knowledge attained from the process of building and evaluating the artifact. This acts as the key difference between design and design research, where the contribution is to the archival knowledge base of foundations and methodologies. In the case of this research, the primary artifact being built and evaluated will be a gamification design framework, a method and set of design principles that promote the design of effective gamification. Hevner et al. (2004) stress that Information Systems (IS) research links, and contributes, to both environment and knowledge base. The contribution to the environment includes addressing the organisational needs and the contribution to the knowledge base includes new foundations and methodologies that can be used in future research.

A three-cycle view of DSR has been proposed (Hevner, 2007) to aid in the construction and validation of DSR results. The three cycles include a relevance, design and rigour cycles. The relevance cycle ties the DSR to the environment through the identification of requirements and field-testing. The design cycle iterates between the build and evaluate activities of developing a DSR artifact. The rigour cycle grounds the research in terms of the knowledge base and also provides additions to the knowledge base. The Design Science Research Methodology (DSRM) Process Model has also been proposed to make it easier to undertake DSR research (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). The DSRM aids in the production and presentation of design science research, notably in the area of IS research. The model takes the building and evaluating loop, and breaks into six stages (see Figure 2.2).

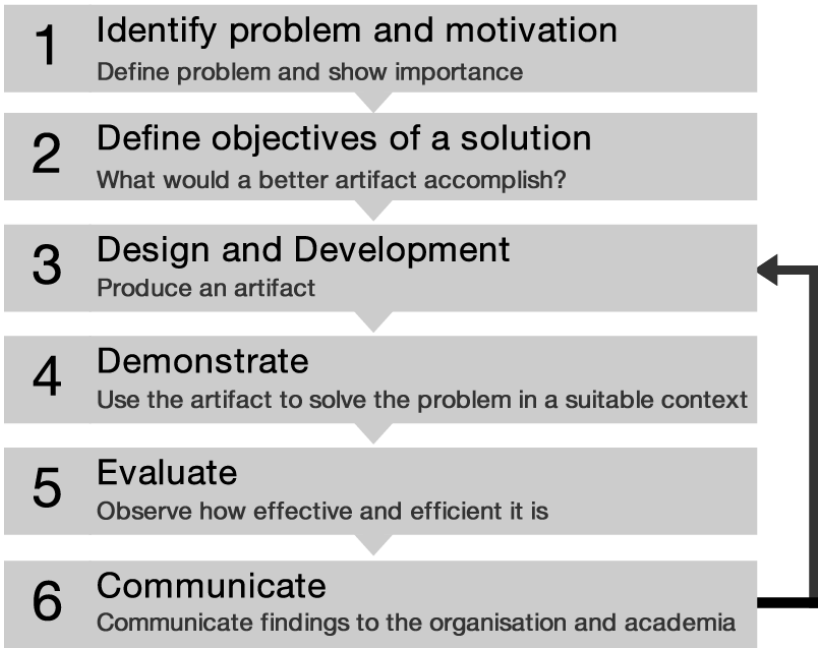

Figure 2.1 - DSRM Research Stages (adapted from Peffers et al., 2007)

The DSRM has similarities to the three-cycle view of DSR, where the activities in each of the stages can be tied to one or more of the cycles proposed by Hevner (2007). The DSRM provides a structured and detailed guide to undertaking DSR, which is useful for this research.

2.5 THE INITIAL GAMIFICATION DESIGN FRAMEWORK

An initial gamification design framework is proposed as a way to operationalise the gamification design process used in previous research and industry examples. This framework breaks the design of gamification into three steps: identifying *goals* of a particular activity and linking these goals to game *elements* using available *sensing.* The gamification design framework is not meant to replace a design process (e.g., user-centered or iterative design), but instead, to complement it by providing additional activities related to gamification design.

2.5.1 PROBLEM AND MOTIVATION

Gamification is becoming a popular design strategy for engaging users in non-game contexts. However, very few guidelines exist for designing gamification. Previous gamification research has primarily focused on looking at the effects of gamification, rather than investigating the design of it. Behaviour change has been the primary construct investigated by most previous empirical research. Results from these previous studies indicate that the addition of game elements can lead to an increase in a desired behaviour. However, how to effectively design for this behaviour change needs clarification, as well as an investigation into the effect of gamification on other constructs that may affect a user's experience. Further research is needed that looks at the effect of gamification on constructs of usability and playability. Investigating this will not only help to design better gamification: it will also aid in understanding if gamification is a viable design strategy.

The literature review revealed that the design process for gamification implementations used in previous research was often not discussed. For the research that did provide an overview of the design process used, it was found that these processes varied widely from one study to the next. The gamification designs in some studies were based on game design theory, others used processes from HCI design, and others simply drew on the design experience and knowledge of the researchers. There were currently no operationalised and evaluated guidelines

found in the literature that aid in designing gamification. Some useful design tools do exist that have been adopted for gamification design, such as Malone's heuristics (1981) for designing game-like interfaces. These have proved useful, but they are not specific to gamification design and are derived from outdated games. A number of gamification frameworks have been proposed for designing gamification for specific contexts, such as for calibration games (Flatla et al., 2011) or authentication games (Kroeze & Olivier, 2012). Researchers have also adopted methods from other areas such as HCI and game design, or they are using their own techniques for designing gamification. However, there are additional unique challenges that may arise when adding game elements to non-game contexts. The addition of game elements may lead to different outcomes depending on the design, users, and context. Adding game elements to a non-game context may also interfere with aspects such as usability, or may create playability problems such as cheating. Therefore, guidance is needed to aid in designing effective gamification designs.

2.5.2 OBJECTIVES OF A SOLUTION

To address the lack of gamification design guidelines, an operationalised and evaluated gamification design framework can be introduced to aid in the design of effective gamification. A framework such as this should consider the users and the context of the system being gamified. It should also help to guide the designer through any unique problems that may arise when designing gamification systems. The primary objective of a providing a gamification design framework is therefore to aid in designing an effective gamified system. An effective gamification system is defined in terms of this research is a system that leads to appropriate behaviour change, does not affect the usability of the tool, and provides an enjoyable player experience. In addition to this primary objective, the framework should provide guidance on how to:

- Identify suitable goals for a gamification design
- Choose game elements that align to the goals
- Implement the game elements using the available technology

2.5.3 DECONSTRUCTING GAMIFICATION

Gamification is defined as the use of game design elements in non-game contexts, where a game design element includes anything from game aesthetics, such as graphics and progress bars, to complete games, with overarching goals, rules, story, levels, quests and achievements (Deterding et al., 2011). Game elements are used primarily to further promote a serious goal – often user engagement or motivation. To enforce the game elements, user interaction with the system is identified and used as input. In this way, a gamification design could generally be divided into three layers:

- Goals – the desired user behaviours driven by the specific problem and goals identified.
- Sensing – the triggers identified based on the available sensing that detects activity and interaction and feeds it to the game layer.
- Game – the game elements chosen to promote the desired activity: given the input from the technology, the game enforces the rules and provides feedback to the user.

These three layers can be found in existing gamified systems. For example, the *Movipill* system (de Oliveira, 2010) was built to address issues of medication compliance. A gamified application was developed which had the serious goal of encouraging users to take their medication on time. Sensors were added to a pillbox that reported the time medication had been taken. Combining this trigger with the user's prescription information meant the game was able to identify whether a user had taken their medication at the prescribed time. Reward-based game elements were used, specifically points and a leaderboard, to encourage compliance. Users received more points the closer they took their medication to the prescribed time, and then they could compare their score to other users.

Using the three layers above, the Movipill gamification design can be described as in Table 2.2.

Goals	Medication compliance (i.e., patients taking their pills at the prescribed time)
Sensing	A pillbox embedded with a sensor that registered two cues (date, time) when opened; this was combined with user information and prescription schedule to provide a trigger.
Game	Points were awarded depending on how close a player took their medication to the time prescribed to them, more points for being closer to the time. A weekly leaderboard compared their total score to others users who were playing also.

Table 2.2 - Describing Movipill (de Oliveira, 2010) using the three layers

Describing an existing gamified design in this way aids in better understanding the design choices and implementation of the system. It also can aid in analysing the design and finding potential issues within each layer of the system. Take for example the sensing layer of *Movipill*: the system registers when the pillbox is opened, but how does the system know the pill was actually taken? Look at the game layer: what happens when one person is prescribed to take more medication than someone else? Because they are using the pillbox more frequently, do they then gain more points, thus giving them an unfair advantage in the game?

2.5.4 THE INITIAL GAMIFICATION DESIGN FRAMEWORK

These three layers can also be used as a basis for a framework for gamification design where within each layer of the framework, general tasks can be prescribed in order to aid in the design.

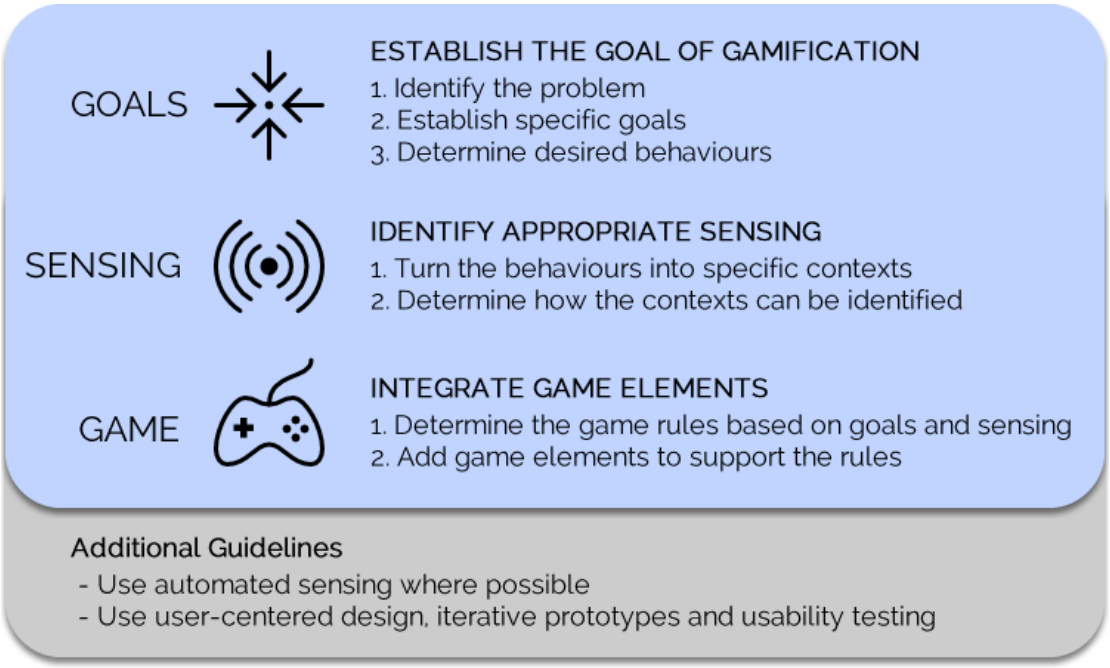

Figure 2.2 – Gamification Design Framework

The framework and its individual layers are discussed below.

GOALS

Gamification design begins by identifying a problem, establishing specific goals, and then determining desired user behaviour. The problem that the designer addresses should clearly be identified (e.g., people are not getting enough exercise). Based on the problem, high-level goals can be established which address the problem in some way (e.g., undertake regular exercise). Based on these high-level goals, specific behaviours can be determined as key performance indicators that goals have been met (e.g., undertake thirty minutes of high-intensity exercise every day).

Problems, goals, and behaviours may be identified and gathered in a variety of ways, such as by reviewing previous literature, or undertaking questionnaires, interviews, focus groups, workshops, observation, and studying documentation (Rogers et al., 2011). The findings of this stage drive the rest of the gamification design.

SENSING

Once the desired behaviours have been identified, the next step is to find the most automatic and accurate way in which to sense them. There are three primary ways in which game elements can be enforced in gamification systems. The first is to automatically capture interactions using sensors and use this as game input. For example the medication reminder system *Movipill* used a physical sensor that detected when the pillbox was opened (de Oliveria et al., 2011). Crowdsourcing has also been used to enforce game elements: for example, the *ESP Game* used crowdsourcing to accurately tag images. The game relied on matching an image descriptor tag given by one player with another player to make sure the tag was reliable (Von Ahn & Dabbish, 2004). Other applications rely on self-enforced game elements, such as the to-do list application, *Epic Win!* This application let users mark off tasks as they completed them, which triggered rewards in the game.

Sensors have been divided into three different groups: physical, virtual and logical sensors (Indulska & Sutton, 2003). Physical sensors are hardware sensors in devices that can capture physical data on a user and their environment, for example, location, movement, or temperature data. Virtual sensors can obtain context data from software applications or services, for example, current computer logins or search history. Logical sensors combine both physical and virtual sensors to solve higher tasks, for example, locating an employee by using her current login at a desktop PC and mapping that to device location information (Baldauf, Dustdar, & Rosenberg, 2007). Taking values from a single sensor can create different cues. Combining these cues together can help determine various contexts, as shown in Table 2.3.

Context	Cues
In the office	Artificial light, stationary or walking, room temperature, dry
Jogging	Natural light (cloudy or sunny), walking or running, dry or raining, high pulse

Table 2.3 - Contexts described as cues (Schmidt, Beigl, and Gellerson, 1999)

A combination of various cues can be used to describe a range of available contexts that can be used as mechanics for the gamification design. For desktop and web applications, virtual sensors would act as the primary source of available context, as few physical sensors are available on desktop machines. This would include sensing interactions with software applications. For example, on the *AusGamers* website (AusGamers, 2012) user actions such as watching videos, downloading files and making forum posts are used as input to unlock various achievements on their website. On mobile devices, current commodity smartphones include a range of cheap and powerful physical sensors such as an accelerometer, digital compass, gyroscope, location, microphone, and camera (Lane et al., 2010). These provide an opportunity to sense a much larger range of contexts. However, not all interactions can be automatically sensed using technology.

The clear advantage of automatically capturing interactions using sensors is that players do not need to enforce the gamification rules themselves. Relieving players of the burden of implementing the game rules is one of the most important benefits that technology brings to games (Adams, 2010). A range of different activities can be measured these days on both desktop and mobile applications. If activities cannot be captured automatically, then crowdsourcing or self-enforcement techniques may be a suitable alternative. Although these techniques can be used as alternatives, they also have various downsides. Crowdsourcing gamification enforcement needs a willing community who will give their time to enforce the elements. If game elements are self-enforced instead, then users have the chance to play unfairly or to cheat more, as they are in charge of enforcing the rules.

Therefore, using automatic sensing techniques should be considered first as they provide the best way to enforce gamification elements. If they are unable to successfully measure the desired behaviours then using crowdsourcing or self-enforcement can be explored.

GAME

The available sensed actions can then be taken and used as game input, creating a game experience to support the goals established. Once behaviours can be sensed, they can be turned into input for the game layer. Game rules can be determined that promote the desired behaviours, and other game elements can be chosen to support the experience. This may involve the addition of a range of different game design elements, for example, using graphics and narrative to set the scene, using points, levels and progress bars as feedback, or using quests, achievements and goals to create challenges. Reward- and competition-based game elements such as badges, points, and leaderboards were popular elements explored recently in a number of studies (e.g., Montola, 2009; de Oliveira, 2010). Depending on which game design elements are chosen, the design of these can be informed by the underlying goals and activities, and implemented using the available context sensing.

2.5.5 USING HCI DESIGN METHODS AND PROCESSES

To aid in the gamification design, alongside the framework, a user-centered design approach may be worth undertaking, along with iterative rapid prototyping and usability testing.

USER-CENTERED DESIGN APPROACH

A user-centered design approach focuses on understanding the goals and needs of the user, and will often involve obtaining feedback during the design stage. For example, Cafazzo et al. (2012) interviewed six users to gather design requirements for a gamified mobile health application for managing adolescent type-1 diabetes. User feedback can also aid during the design process: for example, when *Ubi-green* was being

designed, online questionnaires were sent to users to gather feedback on early prototypes (Froehlich et al., 2009).

ITERATIVE RAPID PROTOTYPING

Iterative rapid prototyping encourages the creation of a number of prototypes that can be used to identify design issues and mitigate risks. These may be very low-fidelity prototypes such as wireframes drawn on paper, or may be more functional prototypes that allow for testing specific parts of an application. For example, Pollak et al. (2010) extensively tested prototypes of a mobile game that promoted healthy eating before deploying it to the target demographic. Grimes et al. (2010) studied a mobile health game built for adults. The design of this game went through a number of iterations, influenced by brainstorming and feedback sessions with HCI researchers, game design experts, and also a dietician. Law et al. (2011) used paper and digital prototypes to help design a gamified mobile application for capturing photos of road accidents.

USABILITY TESTING

Usability testing is an important part of determining whether a system is functioning as expected. Very few examples of previous gamified system research have reported employing usability testing. In fact, the results of one study could have been improved by employing usability testing. Guin et al., (2012) investigated the effect of game elements added to an online market research survey. The study compared three non-gamified surveys to a gamified version. Each of the three non-gamified surveys attained completion rates of around 94%, but the gamified version had a completion rate of only 58%. The authors note that a usability issue could have contributed to many respondents abandoning the survey while the game was loading or during the introduction, because it took longer to load than the other surveys (Guin et al., 2012). A usability study may have helped to identify this before it became an issue and affected study results.

2.5.6 ADDRESSING POTENTIAL GAMIFICATION ISSUES

The literature also identified a number of potential issues needing to be considered when designing gamified experiences, notably preference and cheating issues. Montola et al. (2009) found that some users did not appreciate the added game elements, saying that they were distracting, confusing and unnecessary. Adding game elements also encouraged cheating in a number of studies (Froelich et al., 2009; Singer & Shneider, 2012; and Xu et al., 2012). Both these issues of preference and cheating should be addressed during the design, as they could negatively impact the overall user experience.

2.5.7 POTENTIAL ADVANTAGES AND LIMITATIONS OF THE FRAMEWORK

As noted earlier, this framework is not meant to replace a particular design process chosen (e.g., user-centered design), but rather, to support it by dividing the gamification design of an application into three layers, suggesting various activities and processes that may be useful. The advantage of this approach is that it provides a simple way to break down a gamification design, helping to identify the goals to be addressed by the game elements and how they can be enforced by the technology available. A limitation of this framework is that it may be too general and does not explicitly discuss the choice or design of the game elements to be used in the design. This choice depends on what the researcher intends to investigate and if the aim is to study the effect of one particular game design element or to design a more detailed gamification experience.

2.6 CHAPTER SUMMARY

This literature review chapter provided a definition of gamification, looked at the impact of previous empirical research into gamification, explored previous gamification design processes, proposed research questions and a research method, and outlined an initial gamification design framework. The results of this chapter indicate that adding game elements to non-game contexts has mixed results, quite contrary to

industry thinking. Adding game elements may promote short- or long-term behaviour change, or it may also have negative effects on the user's experience. Very few general gamification design currently guidelines exist to aid in the design of effective gamification. Therefore, an initial gamification design framework was proposed as the basis of this research.

3. RESEARCH DESIGN

The primary goals of this research were to investigate effective gamification design, develop a gamification design framework, and evaluate its effectiveness. To address these goals a three-step research framework influenced by Design Science Research (DSR) was used. This chapter details the research framework and discusses the research methods used for each step.

3.1 RESEARCH METHODOLOGY

This research adopted a Design Science Research (DSR) approach, using the Design Science Research Model in particular, to guide the research steps (Peffers et al., 2007). A gamification design framework, proposed as an artifact, was evaluated and improved using two iterations of design and evaluation. These iterations involved using the artifact to design a gamified smartphone application for two different contexts. A mixed method HCI research inquiry with a control application was used to determine the effects of the added gamification. The artifact was evaluated and iterated based on the findings. Individually these studies provide an understanding of the effect of two different gamification designs in different contexts, contributing to each organisation and academia. Collectively both studies provide insight and feedback into the usefulness of the gamification design framework.

The research investigation began with an exploratory stage to justify the context and then moved into two build-evaluate loops that focused on building and evaluating the artifact. Various DSRM activities aligned with each stage of this proposed framework (see Figure 3.1).

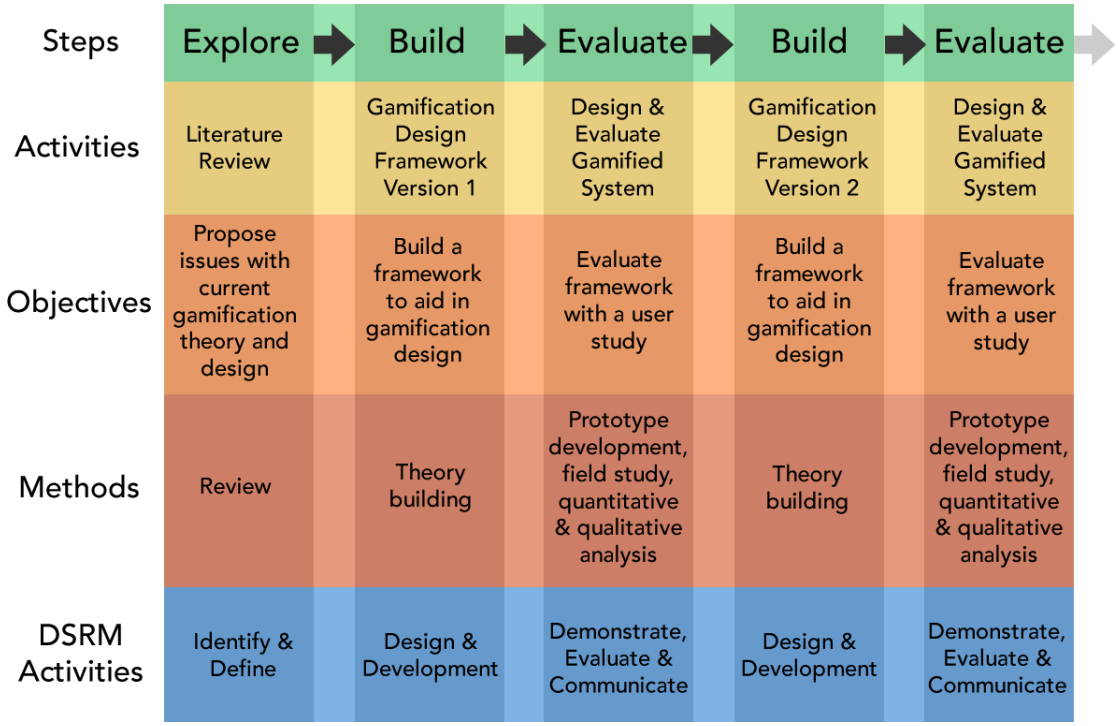

Figure 3.1 - Research framework

The first step was an exploratory step that justified the research and identified the current problems associated with gamification design. This was addressed through a literature review, which has revealed gaps in previous gamification research and which also identified important areas to be addressed when trying to create effective gamification design. Following this exploratory step were two build-evaluate loops. An initial gamification design framework was proposed and was used to build a gamified application for a university orientation context. The gamified application and design framework were evaluated and the results of the evaluation communicated to the university and were published in various academic avenues. Based on the results a second version of the design framework was proposed and used to build a gamified application for a learner driver context. It was evaluated in a similar way, and the results also shared with the organisation and academia. The results led to some minor changes to the framework and a proposal for future research.

3.2 RESEARCH METHODS AND DATA COLLECTION

As discussed in the literature review, previous empirical research into gamification used a range of different research methods in order to obtain results. Of all the methods, field research was the most common. Field experiments that were undertaken often compared two different applications, one with game elements and one without. It was common for mixed-method research to occur alongside field studies. Interviews and surveys were often administered to gather data on the subjective experience of the user, while usage data automatically collected by the device reported on objective user motivation.

A similar approach was adopted for this research investigation: it uses a range of different user study methods and tools to measure the proposed constructs. This includes both quantitative and qualitative measures, as using a mixed-method approach for data collection can help to increase the validity of the results and can also aid in a better understanding of the findings. The gamification design framework was used to design two different gamified applications. To determine if the framework was useful for designing effective gamification, field studies were used to evaluate these applications. During these field studies usage data was logged, surveys were administered, and interviews were undertaken. The results were analysed using appropriate data analysis methods to determine if the gamification was effective; this in turn provided evidence to support the usefulness of the gamification design framework.

3.2.1 PROTOTYPE DEVELOPMENT

Rather than evaluating gamification added to an existing system, the PhD candidate designed and developed mobile application prototypes for the studies and added game elements to these. This meant that more work was involved, but developing new prototypes for research brings a number of benefits, such as making it easier to create a non-gamified control and then making it easier to add and adjust the gamification experience used. In addition to this, tools for gathering usage data were integrated easily into both the gamified and non-gamified versions. The

development of prototypes like this has been common other similar studies (e.g., de Oliveira et al., 2010; Flatla et al., 2011; Montola et al., 2009).

3.2.2 FIELD STUDY

A popular way to evaluate gamified systems in previous research investigations has been to use a field study (e.g., Montola et al., 2009). Compared to a laboratory experiment, a field study provides the ability to examine an intervention in a realistic setting. However, there are limitations that need to be considered when using a field study. There is less control over the environment, a potential lack of internal validity, and also the potential for confounding variables (Bhattacherjee, 2012). On the other hand, a field study may provide better external validity of results. During the field studies undertaken in this research, both quantitative and qualitative data were gathered in an attempt to validate data through data triangulation (Bogdan & Biklen, 1998). Different sources of data included usage data, questionnaire surveys, and interview transcripts.

3.2.3 LOGGING USAGE DATA

Logging application usage data provides quantitative data that can be analysed to determine the effect gamification has on behaviour change. The benefits of logging usage data is that it is automatic and unobtrusive, does not require a researcher present, and can provide quantitative data that could not be as captured easily through observation or self-reporting measures.

3.2.4 QUESTIONNAIRE SURVEYS

Certain subjective constructs cannot be measured by logging usage data alone. Surveys involve the use of standardised and questionnaires to collect data that may otherwise be unobservable (Bhattacherjee, 2012). In this way, they are useful tools for gathering subjective data and have been used by previous gamification research studies to understand further the effect of game elements on constructs such as enjoyment and

fun (e.g., Flatla et al., 2011). In this research, surveys were administered during or after the field studies in order to measure user experience constructs and subjective motivation. These are detailed later in the chapter.

The advantage of using surveys is that they are convenient and easy to administer (especially when administered remotely via online survey software) and a broad range of data can be collected (Bhattacherjee, 2012). However, surveys do have a number of disadvantages that need to be considered. An important one is that respondents may not provide accurate or honest answers to questions in the survey, so it can be difficult sometimes to explain some of the quantitative data collected. Such problems need to be taken into account when designing the survey. Negative and positive items can be used to check for answer accuracy and short-answer responses can be included to help explain the quantitative results.

3.2.5 INTERVIEWS

Interviews were undertaken as a means to justify the application of gamification in each context and validate literature findings. Interviews were also used in the learner logbook field study to triangulate and explain the quantitative results. Interviews are a useful research method for in-depth investigations of issues (Bhattacherjee, 2012). They can be used to help understand a particular issue and also can be used to help explain quantitative results. The advantages of using interviews are that they can be used to obtain detailed information about feelings, perceptions and opinions, and they also allow for more detailed questions to be asked (Bhattacherjee, 2012). If the interviews are semi-structured then they allow the interviewer to follow up on answers and ask additional questions to probe further. The disadvantage of interviews is that they can be time-consuming to undertake, transcribe and code.

3.3 THE FIRST BUILD AND EVALUATE ITERATION

After identifying the research problem and its motivation, and defining the objectives for a gamification design framework, the third activity in DSRM involves determining the desired functionality of the artifact and then creating it (Peffers et al., 2007). In this case, the artifact was the gamification design framework: an initial gamification design framework was proposed drawn from the findings of the literature review.

3.3.1 FIRST DEMONSTRATION

DSRM then suggests that the artifact be used to solve one or more instances of the problem, which could include its use in an experiment, case study or other appropriate activity (Peffers et al., 2007). For this research, a case study was undertaken for university orientation. The framework was used to design a gamification experience for new students attending university orientation at the Queensland University of Technology (QUT). The added gamification aimed to engage students further with orientation information and events.

The context for this demonstration must be justified and design requirements identified. In this way, the following research activities were identified and undertaken for this purpose:

- A review of the past two QUT Student Orientation Surveys from 2010 to identify issues that students have at orientation.
- A review of current orientation services provided at QUT (e.g., event planner, maps, QUT iPhone application).
- An interview with two key staff from the QUT Student Engagement Team.
- A focus group with eight staff from the QUT Orientation Planning Group to turn orientation goals into design requirements for the gamification experience.

These results of these activities helped justify the context for intervention by identifying a desired behaviour that could be motivated further

through gamification. This is detailed further in Chapter 4. Following this, the gamification experience was designed using the initial gamification design framework proposed in the literature review. This experience was designed for, and embedded into, an orientation event application built for new university students. The event application provided a personalised list of orientation events, a context-aware map of the university, a friend list, and important information about university services. The added gamification experience provided a list of challenges in the form of an achievement system for students to complete while on campus.

3.3.2 FIRST EVALUATION

In order to evaluate the first version of the gamification design framework a field study was used to determine the effect of the added gamification. The results aimed to demonstrate how effectively the artifact performed in the context, and to find if it provided a solution to the problem (Peffers et al., 2007). In this case the evaluation provided a way to determine if using the gamification design framework would result in an effective gamification experience as well as give insight into why the gamification design did or did not work in the environment.

AIMS, CONSTRUCTS, HYPOTHESES AND RESEARCH QUESTIONS

The purpose of the study was to investigate whether the use of the gamification design framework resulted in an effective gamification design – one that did not affect user experience, encouraged motivation, and behaviour change, and also provided an enjoyable gamification experience. Therefore, the aims of the evaluation included:

1. Comparing the user experience of participants using the gamified application to participants using the non-gamified application
2. Investigating the effect on the motivation to undertake orientation tasks, and behaviour change, when using the gamified application compared to participants using the non-gamified application
3. Identifying if the gamification design was enjoyable and if it caused any unusual problems

The constructs investigated in the study included: user experience, perceived motivation, behaviour change, and gamification experience. Based on these constructs three hypotheses were established that could be tested in a field study:

1. Participants using the gamified application had a more positive user experience compared to participants using the non-gamified application.
2. Participants using the gamified application felt more subjectively motivated compared to participants using the non-gamified application.
3. Participants using the gamified application were undertook more orientation activities compared to the non-gamified application.

In addition to these three hypotheses, a research question was also investigated:

1. Is the addition of game elements well received by university students?

MEASURES

To measure the constructs, usage information was captured during the field study and a questionnaire was administered to participants at the end of the field study. The questionnaire design was informed by a questionnaire used in a similar study (Schwabe & Göth, 2005). The questionnaire was divided into five sections:

- Section 1: Demographic Information
    - Asked questions regarding previous use of smart phones, event applications, games, and achievement systems.
- Section 2: Orientation Application Usage and Feedback
    - Asked questions regarding the usefulness, user experience and motivation of the prototype.
- Section 3: Game Aspects and Achievement System Feedback
    - If they used the gamified version, this section asked questions regarding the usefulness, experience, and motivation

of the gamification design. If the participant was using the non-gamified prototype, they were introduced to the gamification design and asked for feedback.

- Section 4: Improvements and Future Uses
    - Asked questions regarding improvements and future additions.
- Section 5: Additional Comments and Notes
    - Provided screenshots of the game prototype where participants could provide feedback for specific screens.

The questionnaire used a combination of 5-point Likert-type questions with short answer responses in order to obtain feedback for the variables of each construct. Responses for the 5-point Likert-type questions included Strongly Disagree (1), Disagree (2), Neither Agree or Disagree (3), Agree (4), and Strongly Agree (5). For questions relating to the usefulness of the application (e.g., "How useful was the list of events?") the 5-point Likert-type question responses included Not at all useful (1), Very little use (2), Useful (3), Very Useful (4), Extremely Useful (5).

To measure user experience a four-item Likert-scale was developed (*"I found the application to be overall useful", "I found the application easy to use", "I enjoyed using the application", "The design of the application was attractive"*). To measure the perceived motivation of participants a nine-item Likert-scale was developed (*"The application motivated me to explore more of the campus", "I found and visited new places on campus that I would not have visited without the application", "By using the application I got to know the university campus well", "The application helped me to learn about the different locations on campus", "The application encouraged me to meet new people", "This application would encourage me to meet other students in my faculty and course" ,"The application encouraged me to attend events", "The application encouraged me to check-in to events", "The application helped to engage me in the orientation event"*). To assess the reliability of the scales, Chronbach's alpha was calculated for both the gamified and non-gamified responses, the two scales were found to have acceptable reliability (alpha 0.768 for the perceived motivation scale and 0.765 for the user-experience scale).

Five-point Likert-type questions were used to measure the usefulness of specific application features with responses on the following scale (Not at all useful (1), Very little use (2), Useful (3), Very Useful (4), and Extremely Useful (5)). Specific features included the campus map (*"How useful was the map of the campus?"*), check in function (*"How useful was the ability to check into an event?"*) and bump function (*"How useful was adding friends by bumping phones together?*).

The application also captured usage information, including the number of events a participant checked-in to, the number of friends added to the friend list and if participants were using the gamified version, the total number of achievements completed was also captured. Short answer questions gathered qualitative data to support the quantitative findings.

The subjective gamification experience was measured of participants who used the gamified application using Likert-type questions with the same scale as the user experience and perceived motivation questions (e.g., *"The achievement system was fun to use", "The clues in the achievement system were easy to understand", "The achievement system motivated me to explore the campus")*, multiple choice questions (e.g., *"What did you like the most about the design of the achievement system?", "What was your favourite type of achievement to complete?"*) and short answer questions (e.g., *"Of all the achievements you completed pick your two favourite and tell us why you like them", "Do you think the difficulty level of the achievements was appropriate? If no, why not?"*). The complete questionnaire can be found in the appendix.

PARTICIPANTS

New students were chosen as participants to trial the application, as they would be the primary users of such an application. Participants were recruited via a news article posted on the university's orientation website a month before orientation started. There were two requirements for recruiting participants: (1) the participant had to be a first-year student attending university orientation, and (2) they had to own an iOS mobile device on which to test the application, such as an

iPhone, iPod touch or iPad. After completing a questionnaire and collecting their log data, participants received two free movie tickets for their participation in the field study.

The aim was to recruit at least 20 students for each version of the application. The sample size was limited due to the time constraints of orientation, and to the required administration time. The application was built for orientation at QUT Garden's Point campus, which runs for three days (Monday – Wednesday). Installing and explaining the application, as well as administering the survey, took at least 30 minutes for each participant. Using at least 20 participants would produce a confidence level of 95% with a margin of error of +/- 19% (Creative Research Systems, 2012). To obtain a margin of error of +/-10%, at least 71 students would need to have been recruited, a number difficult to obtain considering the study circumstances. A total of 46 first-year university students (male = 31, female = 15) were recruited to participate in the field study. A total of 26 students used the gamified application during orientation week and 20 used a control version (non-gamified).

PROCEDURE

The field study was run during orientation week in semester 1 2011. Each participant used one of two versions of the event application for a day, distributed randomly. Application usage information was captured and a questionnaire administered at the end of the field study. The researcher met the participants when they arrived at orientation and provided them with a link to download the application onto their mobile device. Their customised event list was then set up and an introduction to the application was provided. Participants were asked to use the application while at orientation and to return at the end of the day to provide feedback on their experience. Application usage information was captured on the device and sent to the researcher via email. This information provided an overview of the achievements completed by the student, the number of events attended and the number of friends added to the friend list. When the participant returned, the usage data was emailed to the researcher and the participants completed the questionnaire. Once the survey was completed participants were thanked for their time and given two movie tickets.

ANALYSIS

A statistical analysis was undertaken on the data using IBM SPSS (Statistical Package for the Social Sciences) software. The study used a between-group design, with comparisons being made between the two independent groups. One group used a gamified version; the other, a non-gamified version. Because Likert-type and Likert-scale items are interpreted as being ordinal data, non-parametric methods were used to determine if there were any differences between the two groups for these dependent variables. In particular, the Mann-Whitney U test was used as it is a rank-based nonparametric test used to determine any differences between two groups on an ordinal dependent variable (Laerd, 2013). For any continuous variables an independent-samples t-test was used to determine if a difference existed between the means of the two independent groups (Laerd, 2013). This test was used to determine if there are any demographical differences between the two groups or any differences between number of events attended and friends added. Any short-answer feedback was coded to see if statements supported the quantitative results.

3.3.3 COMMUNICATION

The results of the evaluation were communicated to the university and research community, an important part of DSR (Hevner et al., 2004). This included reporting on the importance of the study, the artifact and its utility and novelty, design rigor and effectiveness (Peffers et al., 2007). A total of five peer-reviewed academic papers were published based on the results and feedback reports detailing the research outcomes were provided to the organisation and funding body of the research (Smart Services CRC).

3.4 SECOND BUILD AND EVALUATE ITERATION

A second build-evaluate iteration was then undertaken in order to improve the artifact. Based on the evaluation of the previous field study, changes were made to the gamification design framework (March & Smith, 1995) to address issues relating to the three constructs being investigated. The updated framework was then used to design a gamification experience for learner drivers undertaking their mandatory 100 hours practice in Queensland, Australia. The added gamification aimed to motivate learners in undertaking more diverse practice.

3.4.1 SECOND DEMONSTRATION

The updated design framework was used to build a gamified logbook application for learner drivers in Queensland, Australia. A different context was chosen to design a gamification experience for due to the limitations of the first study. The primary limitation being that a realistic field study needed to be run during orientation week, which occurred only twice a year for a week. If the study was not ready then it was delayed for six months. The new context focused on a similar user demographic, but the study could be run at any time throughout the year.

The following research activities were undertaken to justify the context and identify design requirements for the gamified application:

- A review of related research on national learner driver programs
- A review of current driving services provided (Official logbook and unofficial logbook applications)
- Interviews with five experts in the field of Learner Drivers from academia, industry and government

These results of these activities helped justify the context for intervention by identifying a desired behaviour that could be motivated further through gamification. This is detailed further in Chapter 7. Following this, the gamification experience was designed using the updated gamification design framework proposed. This experience was designed for,

and embedded into, a logbook application for learner drivers. The logbook application recorded driving practice and also provides a summary of total practice undertaken. The added gamification experience provided a virtual road trip challenge which aimed to encourage learners to undertake more diverse supervised practice.

3.4.2 SECOND EVALUATION

In order to evaluate the updated version of the gamification design framework a field study was used to determine the effect of the added gamification. Twenty-five learner drivers were recruited to try a gamified and non-gamified version of the application over a four-week period. Similar to the first evaluation, the results aimed to demonstrate how well the artifact performed in the context, and if it provided a solution to the problem (Peffers et al., 2007). In this case the evaluation aimed to determine if using the updated gamification design framework resulted in an effective gamification experience. Again, the results of the evaluation aimed to determine why and how the artifact worked or did not work within the environment.

AIMS, CONSTRUCTS, HYPOTHESES AND RESEARCH QUESTIONS

The purpose of the study was to investigate if the use of the gamification design framework resulted in an effective gamification design – one that did not affect user experience, encouraged motivation and also provided an enjoyable gamification experience. Therefore, the aims of the evaluation included:

1. Comparing the user experience of participants using the gamified application to that of participants using the non-gamified application
2. Comparing the effect on motivation to undertake diverse practice of participants using the gamified application to that on participants using the non-gamified application
3. Identifying if the gamification design was enjoyable and if it caused any difficulties

The constructs investigated in the study included: user experience, perceived motivation, behaviour change, and gamification experience. Based on these constructs three hypotheses were established that could be tested in a field study:

1. Participants had a more positive user experience when using the gamified application compared to the non-gamified application.
2. Participants felt more subjectively motivated when using the gamified application compared to the non-gamified application.
3. Participants undertook more diverse driving practice when using the gamified application compared to the non-gamified application.

In addition to these three hypotheses, three research questions were also investigated:

1. Is the addition of game elements well received by the participants?
2. Does the addition of game elements negatively affect the ease of use of the gamified application compared to the non-gamified application?
3. Does the addition of game elements lead to any unintended consequences compared to the non-gamified application?

MEASURES

To test the variables, data was gathered from application usage logs and questionnaire data. Driving behaviour data was automatically sent to the researcher each time a learner driver completed a practice session. In addition to the amount of practice undertaken, the skills and the contexts the learner driver were exposed to in each practice session were also captured. Short interviews were undertaken in order to provide more qualitative data to support quantitative findings, and to measure gamification experience. The questionnaire aimed to measure the user experience, motivation and gamification experience of each participant. It combined our own developed measures with validated multi-item measurement scales from Koufaris (2002). The new scales were based on the Technology Acceptance Model and Flow Theory and

were better suited to the new context, compared to the questionnaire used in the previous study.

The questionnaire was divided into four sections:

1. Section 1: Supervised practice experience
    a. This section asked participants to describe their supervised practice over the last two weeks and if any external factors may have affected the amount of practice they undertook.
2. Section 2: Application Experience
    a. This section asked questions about the usability, user experience, and motivation of the prototype, adopted from Koufaris (2002)
3. Section 3: Game Aspects and Achievement System Feedback
    a. If they used the gamified version, this section asked questions regarding the gamification usage, playability, and if they cheated at all
4. Section 4: Further comments

The questionnaire used 7-point Likert-type questions so it was consistent with the questionnaire adopted from Koufaris (2002), which also uses 7-point Likert-type questions. Responses for the 7-point Likert-type questions included Strongly Disagree (1), Disagree (2), Disagree Somewhat (3) Neutral (4), Agree Somewhat (5), Agree (6), and Strongly Agree (7). Short answer responses were also included in order to obtain feedback for the variables of each construct. To assess the reliability of the scales developed for the questionnaire (engagement and motivation), Chronbach's alpha was calculated for both the gamified and non-gamified responses and scales were found to have acceptable reliability (alpha between 0.7 and 0.94)

Table 3.1 outlines the primary measure and example questions used to evaluate the constructs. The complete questionnaire can be found in the appendix.

User Experience Measures	
Concentration/ Attention	• Using a 4-item Likert scale from Ghani et al. (1991 as cited in Koufaris, 2002). (E.g., *"I was absorbed intensely in the activity").*
User Enjoyment	• Using a 4-item Likert scale from Ghani et al. (1991 as cited in Koufaris, 2002). (E.g., *"I found it enjoyable").*
Perceived Control	• Using a 4-item Likert scale from Ghani et al. (1991 as cited in Koufaris, 2002). (E.g., *"I felt in control"*).
Challenge	• Using a 3-item Likert scale from Novak et al. (1998 as cited in Koufaris, 2002). (E.g., *"Using the logbook app provided a good test of my skills"*).
Perceived Ease of Use	• Using a 4-item Likert scale from Venkatesh and Davis (1996 as cited in Koufaris, 2002). (E.g., *"Learning to use the logbook app was easy for me"*).
Perceived Usefulness	• Using a 3-item Likert scale from Venkatesh and Davis (1996 as cited in Koufaris, 2002). (E.g., *"Using the log-book app can improve my driving performance"*). • Using a Likert-type question on usefulness (*"I find the logbook app useful"*).
Application Preference	• Using a preference question (*"Of the two applications, which one did you prefer to use?"*) with three options: *Gamified, Non-gamified,* or *Neither.*
Motivation and Behaviour Change Measures	
Perceived Motivation	• Using a 2-item Likert scale (*"While using the logbook application I found it motivating, "While using the logbook application I found it engaging"*). • Using a preference question (*"Of the two applications, which one was motivating to use?"*) with three options: *Gamified, Non-gamified,* or *Neither.*
Total Practice	• By comparing the median number of practice sessions logged by participants for both versions. • By comparing the median number of minutes prac-ticed by participants for each version of the application • Using a Likert-type question that asked participants whether the game elements motivated them to under-take more practice after they used it. (*"I feel the game elements motivated me to undertake more practice"*). • By asking participants in the interview how each ap-plication affected their practice.

Practice Diversity	• By comparing the average number of logged skills undertaken for each application. • By comparing the average number of logged contexts undertaken for each application. • Using a Likert-type question asking participants whether the game elements motivated them to undertake diverse practice. (*"I feel the game elements motivated me to undertake different types of practice"*). • By asking participants in the interview how each application affected their practice diversity.
Gamification Experience Measures	
Suitable goals	• By asking participants in an interview if they thought the game elements linked to driving practice well, or if anything confused them .
Engagement	• By asking participants in an interview if they thought they would get bored of the game elements over time .
Cheating	• By using two questions on the questionnaire after the road trip version was trialled (*"Did you cheat at all to get extra distance of coins in the Road Trip?", Would you consider cheating at all in the future?").* • By asking participants in the interview if they cheated, or would cheat in the future.
Distractions	• By asking participants in an interview if they found the game elements distracting at all or getting in the way of the application while using it .
Dangers	• By asking participants in an interview if they thought there were any dangers that arose, or may arise from the game elements.
Enjoyment	• Using a Likert-type question on enjoyment on the questionnaire (*"I found the game elements in the app enjoyable"*). • By asking participants during an interview if they liked having game elements as part of the application .

Table 3.1 – Study measure for the logbook field experiment

PARTICIPANTS

Current learner drivers were chosen as participants to trial the application, as they would be the primary users of such an application. Participants were recruited via a Facebook event and also using snowball sampling techniques. There were two requirements for recruiting participants: (1) the participant had to be learning to drive in Queensland Australia, and (2) they had to own and use an iOS mobile device (iPhone, iPod touch or iPad) on which to test the application. Participants received a $50 gift voucher for their participation in the field study.

Given time restraints, and difficulties recruiting participants for a longer study, a within-groups design was used. The aim was to recruit at least 20 learner drivers, between the ages of 16 and 30, to trial both gamified and non-gamified versions of the application. Using 20 participants would produce a confidence level of 95% with a margin of error of +/-19% (Creative Research Systems, 2012). However, to obtain a margin of error of +/-10% at least 71 participants would need to have been recruited, a number difficult to obtain considering the study circumstances. The study aimed to recruit learner drivers from all stages of learning; there was no particular subset of learners that this research focused on. We recruited primarily high school students and first year university students through social networks and snowball sampling. Some participants were over the age of 25, which provided data for those learner drivers who did not have to undertake the mandatory 100 hours of practice. The study also recruited learner drivers in different stages of their mandatory learning period, from Learners at start of their learning period (0 - 4 months), middle (5 - 8 months) and end (9+ months). A total of 25 learner drivers were recruited to try both versions of the logbook application (male = 11, female = 14).

PROCEDURE

A field study was used to evaluate the gamified application. The field study ran for four weeks from July to August in 2013. All the participants tried both a gamified version and a non-gamified version for two weeks each, distributed in a random, counterbalanced order. Two weeks usage provided an adequate snapshot of their driving experience. Application usage data was captured and a questionnaire administered at the end of both two-week periods. Short interviews were also undertaken to gather qualitative data to support usage and questionnaire findings and to probe participants further about their gamification experience.

The study began with a 30-minute introduction session that took place either in person or over the phone before the field study. Participants completed an online questionnaire to provide demographic information. This included gathering information on their gender, smart phone usage and video game usage. They were also interviewed on their current practice habits and experience using the physical logbook. Participants were then given one of the two interventions to install, chosen in a random, counterbalanced order. They were provided with an introduction to the assigned application and were asked to use the application whenever they undertook driving practice over the next two weeks.

During the learner logbook field experiment, the amount and type of practice is recorded, as well as the progression of the game. This data is automatically captured and saved online after every completed practice session. The *Parse* service was used to store this data (Parse, 2013). Parse provides an API (Application Programming Interface) that makes it easy to send data to online storage. The *Flurry* service (Flurry, 2013) was used to capture application usage statistics such as number of times the application was opened and for how long it was used. At the end of the two-week period an online questionnaire was administered. A short phone interview then took place, probing participants for more details about their experience. Participants then deleted the first application and were given a link to download the second version of the applica-

tion. They were asked to use the second version of the application for the next two weeks.

The same procedure was followed for the second intervention. Usage data was captured, and at the end of the procedure an online questionnaire was administered and another phone interview was undertaken. The only difference this time was that a number of additional questions asking participants to compare their experience of both versions of the application were administered in the questionnaire and interview after the second intervention.

ANALYSIS

A statistical analysis is undertaken on the data using IBM SPSS (Statistical Package for the Social Sciences) software. The study used a within-group design with comparisons being made between the same individuals tested under two different conditions on the same dependent variables. Participants used both a gamified version and a non-gamified version of the application. Because Likert-type and Likert-scale items are interpreted as being ordinal data, non-parametric methods were used to study the preference data. Likert-scales and type questions as well as ordinal usage data from each application was compared using a Wilcoxon Signed Ranks Test. To determine the significance of comparison questions that resulted in nominal data a Chi-Square Goodness of Fit Test was used. McNemar's test was used to compare paired proportions and to determine the significance of regular practice data.

The aim of the interviews was to provide additional data that might validate the quantitative data recorded and to provide further insight into why certain results were obtained. To analyse this data, a deductive approach was adopted (Zhang & Wildemuth, 2009). Interviews were prepared for analysis by transcribing the recordings and entering them into NVivo 10 for Windows. Initial coding began with the analysed findings from the questionnaire and usage data. After each interview was coded, themes were formed to help support and explain the quantitative findings.

3.4.3 COMMUNICATION

The results of the evaluation are then communicated to the organisation and research community, an important part of DSR (Hevner et al., 2004). This includes reporting on the importance of the study, the artifact and its utility and novelty, the design rigour and its effectiveness (Peffers et al., 2007). A number of academic papers were written and feedback reports detailing the outcomes of the research were provided to the funding body of the research (Smart Services CRC).

3.5 ETHICAL CLEARANCE

The Queensland University of Technology is committed to researcher integrity and the ethical conduct of research projects and ethical clearance was obtained before any studies with participants were undertaken. Participation in all studies in this research investigation were considered low-risk as there were no risks beyond normal day-to-day living associated with participation in each project. Participation was always voluntary and participants were required to sign a consent form before they could participate in any research activities (or their guardians if participants were under the age of 18). Participants could also withdraw from participation at any time without comment or penalty. Two primary submissions were made, one for the orientation event application and the other for the learner logbook application, as each had different ethical concerns.

3.5.1 ORIENTATION FIELD STUDY CONSIDERATIONS

The primary field study that investigated the effect of a gamified event application used at university orientation had little in the way of ethical concerns. To recruit students a contact from the Student Engagement Centre placed an invitation on the orientation website inviting first year students with iPhones to participate in the study. Any interested students were contacted via email by the researcher and provided instructions on how to participate when they arrived at orientation.

There was the potential risk that scavenger hunt tasks could be designed in a way that encourages incorrect use or harmful behaviour such as entering a closed location or building site. There was also a potential risk that the user study would interfere with the university orientation of the student and a risk that the student's iPhone could be affected by the application.

To minimise these risks the scavenger hunt tasks were designed and reviewed by QUT orientation staff. The scavenger hunt was tested the day before and the morning of the user study to make sure that tasks are still suitable for the study. Students were briefed that they should not enter any places that have restricted access even if the task requires it and that they should report any instances of this to the researcher so other students can be contacted and updated. The risk of interrupting the student's orientation schedule is minimal. In fact the application was more likely to aid the student as the application provided students with a list of their orientation events and a map of QUT. The scavenger hunt could be completed in a student's spare time so the risk of interfering with their orientation program was minimal. The risk of the student's iPhone being affected by the application was minimal. The way the iPhone architecture works is that each application is separate from each other and can't affect or change any part or element of the iPhone aside from anything in the application itself. However, students were still advised to back up their iPhone before bringing it into the user study.

3.5.2 LEARNER LOGBOOK FIELD STUDY CONSIDERATIONS

The primary field study that investigated the effect of a gamified learner logbook application also had little in the way of ethical concerns. Participants were recruited through a Facebook event page was created, university class email lists (with permission from unit co-ordinators), and through snowball sampling where the researcher reached out to contacts in person and via email in order to find potential participants to be involved. Interested participants could sign up via an online form and the researcher would then contact them, or their parent or guardian if they were under the age of 18.

There were minimal risks beyond the normal day-to-day living associated with this study. The learner logbook application had the potential to interfere with a participant's driving routine if used incorrectly. This is because mobile devices are illegal to use while driving. However these risks were considered and managed in the design of the application and the field study.

To mitigate these risks, participants were informed that participation was voluntary and that they could withdraw at any time. They were also told that participation could take place at a time and place convenient for them. Before using the application the researcher discussed with the participant that they could not use the application while driving the car. The participants also needed to read and accept a disclaimer that appeared when the application was first opened. Additionally, the application also provided a reminder not to use the application while driving every time it was used to record practice. Any suggestions that the application provided in terms of driving activities to undertake were derived from consultation with experts and participants were also prompted to discuss anything first with their supervisor.

3.6 CHAPTER SUMMARY

This chapter outlined the research methodology used for the research investigation. A Design Science Research approach was used as a framework, and the Design Science Research Methodology Process Model was used to guide the research. Field studies were chosen as the primary evaluation method for the gamified applications, and within these studies both qualitative and quantitative data were collected to support and triangulate results.

4. DESIGNING A GAMIFICATION EXPERIENCE FOR UNIVERSITY ORIENTATION

This chapter presents a gamification experience, designed using the initial version of the gamification design framework. The gamification experience is integrated into a smartphone application developed to support new students attending university orientation at the Queensland University of Technology (QUT). The added gamification aims to encourage new students to attend orientation events, explore the campus, and make new friends.

4.1 THEORY BUILDING AND TESTING

As gamification first started gaining momentum in industry as a solution for engagement, a common theory was that the use of competitive and reward-based game elements, notably points, badges, or leaderboards, would often result in behaviour change and increased enjoyment. However, the literature revealed mixed results when it came to determining the effect of this type of gamification on behaviour change, some designs affected behaviour change positively and some did not. In addition to this, the literature review also revealed that some gamification implementations occasionally resulted in negative user experiences. This suggests that the design of the gamification plays an important role in the effect it has on the user. This study aims to explore these theories further, focusing on understanding the effect of reward-based game elements created using the gamification design framework proposed in the previous chapter.

4.2 JUSTIFYING A GAMIFIED APPLICATION FOR UNIVERSITY ORIENTATION

University orientation is a key process for new students that aids in the transition from a school to a university environment and acts as an introduction to many important aspects of university. It often entails a weeklong event tailored for new students studying different courses. The event introduces students to university life, the services available

on campus, and to the other students in their cohort. Games will often be played, such as scavenger hunts that encourage campus exploration and icebreaker games that encourage friendships between new students. All of these events and activities are aimed at making the student feel part of the university community and helping to create a comfortable place for learning. Academic, social and personal support for students is vital and will encourage students to remain at university (Reason, Terenzini, & Domingo, 2006).

Current mobile technologies provide new ways in which to engage university students. Technology-mediated services can be more convenient, providing personalised experiences when compared to traditional orientation tools such as paper-based event lists and physical maps. More and more universities are now developing smartphone applications for students that provide a number of university-related services. These applications will often include campus, open day and orientation information, as well as providing event details, staff directories, and context-aware maps. These applications can be useful, but they do not necessarily motivate students to attend the event and engage with other orientation processes. To address this, a gamification solution could be used to further engage students with the event.

Current students are more than likely to be gamers (Bond University, 2009) and orientation games, such as scavenger hunts, have had a history of being used to introduce new students to university (Martin, 2006). Previous research studies have indicated positive results when using games and smartphone technologies at university orientation. For example, the *MobiLearn Project* was an educational scavenger hunt aimed at introducing new students to a university campus (Schwabe & Göth, 2005). Another application called Scavenger Hunt was developed to provide a scavenger hunt around campus for new students using a mobile device (Talton, Peterson, Kamin, Israel, & Al-Muhtadi, 2006). Given these examples, an application for university orientation was an appropriate context in which to investigate the effect of gamification.

In order to justify this line of thinking and context, the following research activities were undertaken:

- A review of two QUT Student Orientation Surveys to identify any problems students were facing at orientation
- A review of current orientation services provided (e.g., event planner, maps, QUT iPhone application)
- Interviews with two key staff from the QUT Student Engagement Team
- A focus group with eight staff from the QUT Orientation Planning Group involving an affinity diagram exercise that organised the goals of orientation into a model

4.2.1 A REVIEW OF PAST ORIENTATION STUDENT SURVEYS

A review of two previous student orientation surveys was undertaken in order to isolate areas of the orientation event in which potential improvements could be made. These surveys, from semesters one and two in 2010, both had the goal of helping determine what QUT students thought of the orientation program in each respective semester. Each survey used a number of different Likert-type questions and short answer responses as measures.

Of the respondents who did not attend orientation in both semesters, just over half responded that they did not think attendance at orientation would have made it easier to settle in at QUT. For those who did attend, 61% in semester one and 76.7% in semester two reported positively that orientation met their expectations, but there were some areas that could be improved. In particular, the results suggest that a number of areas could be improved upon, including: encouraging event attendance, encouraging campus exploration, and encouraging social networking between students.

4.2.2 A REVIEW OF CURRENT ORIENTATION SERVICES

Currently new students sign up to events online and then are encouraged to print out their event list and bring it along to orientation. A number of navigation tools currently exist for students, including sign-

posts that are set up at various locations around the university campus, and online maps of each campus are also available via a web browser and can be printed if a physical copy is required. A QUT iPhone app, released 29 December 2010, provides university information to students and staff and includes a location-aware map with building information. A similar context-aware map would also be useful to include in an orientation smartphone application to help new students navigate the campus.

4.2.3 INTERVIEWS WITH ORIENTATION STAFF

Semi-structured interviews were undertaken with two staff members from the orientation engagement team. Current orientation services were discussed, as well as areas that could be improved based on the survey findings. The interview findings suggested that new students could sometimes feel lost, may have trouble meeting new friends, and may have difficulty finding what events were available. Interviews also revealed that the paper-based event list could be troublesome for both students and staff. Previously, students generally planned their orientation schedule online before the event and then printed out a physical copy of their schedule. However, students could often forget or lose their printout.

4.2.4 A FOCUS GROUP WITH THE ORIENTATION PLANNING GROUP

Following the interviews, a focus group was then run with eight staff members from the orientation-planning group where the issues identified were discussed. An affinity diagram exercise was used to establish specific goals that could be addressed, which involved individual brainstorming and then grouping these ideas.

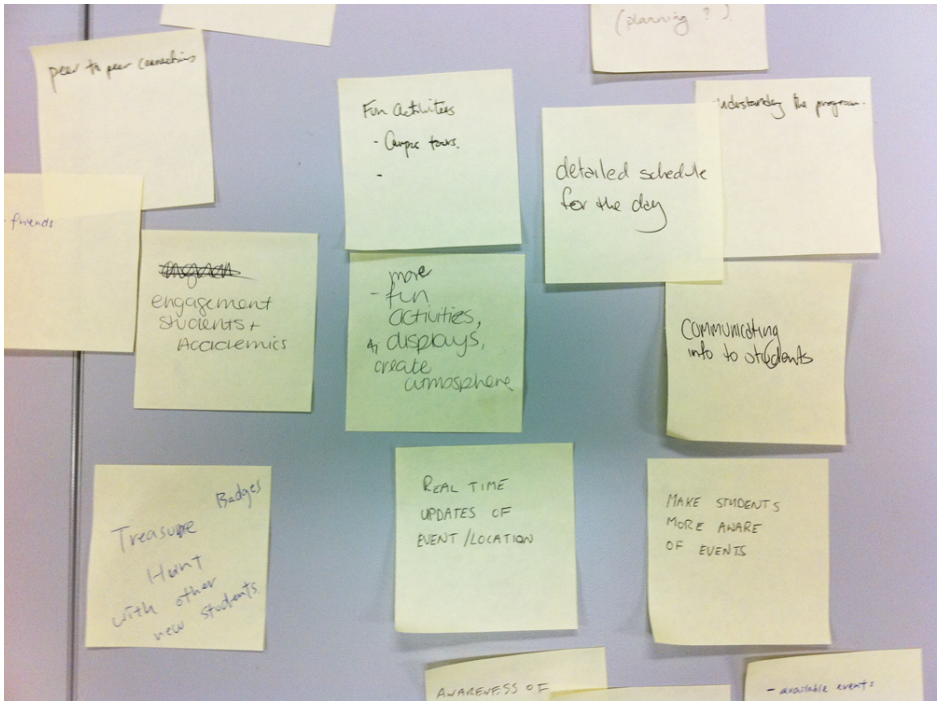

Figure 4.1 - Post-it notes from the affinity diagram exercise

Three different groups emerged from the exercise: these were then used to facilitate further discussion. These three different groups included administration, engagement, and information.

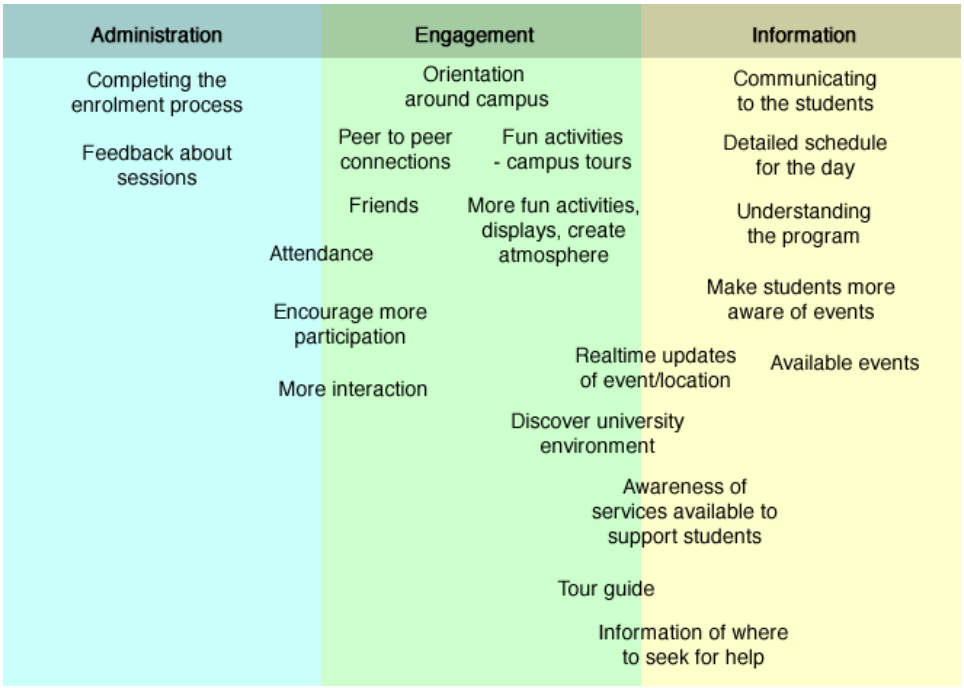

Figure 4.2 – The three groups from of the affinity diagram exercise

The results of the focus group discussion suggested that engagement is a key issue, specifically delivering orientation information to students, encouraging them to explore the campus, and encouraging them to meet people.

Collectively the results from the survey, the interviews and the focus group helped justify the context for this study. Orientation presented itself as an area where gamification could be explored as a way to engage students further in the process. Gamified orientation applications may help to encourage orientation engagement by delivering timely information to students and by encouraging new students to explore the campus and to meet other people.

4.3 ORIENTATION APPLICATION OVERVIEW

The PhD researcher built an orientation event application for this study. This application aimed to support new students attending university orientation. The application provided orientation event information, a map, and a contact list for storing university friend information. The application was developed by the researcher for the Apple iOS platform and could be deployed on iPhone, iPod Touch and iPad devices. At the time of development, Apple was the number one mobile brand in Australia at the time, accounting for 40% of all smartphones shipped (Hanlon, 2011). The platform was also the most popular mobile device for accessing the QUT website at the time of development, according to internal figures.

4.3.1 APPLICATION DESIGN PROCESS

An iterative design approach was used to develop the application. Three iterations of rapid prototype development and evaluation were undertaken. A paper prototype was first created and presented to orientation staff. Feedback was gathered and a digital mockup of the application was made from the results (see Figure 4.3).

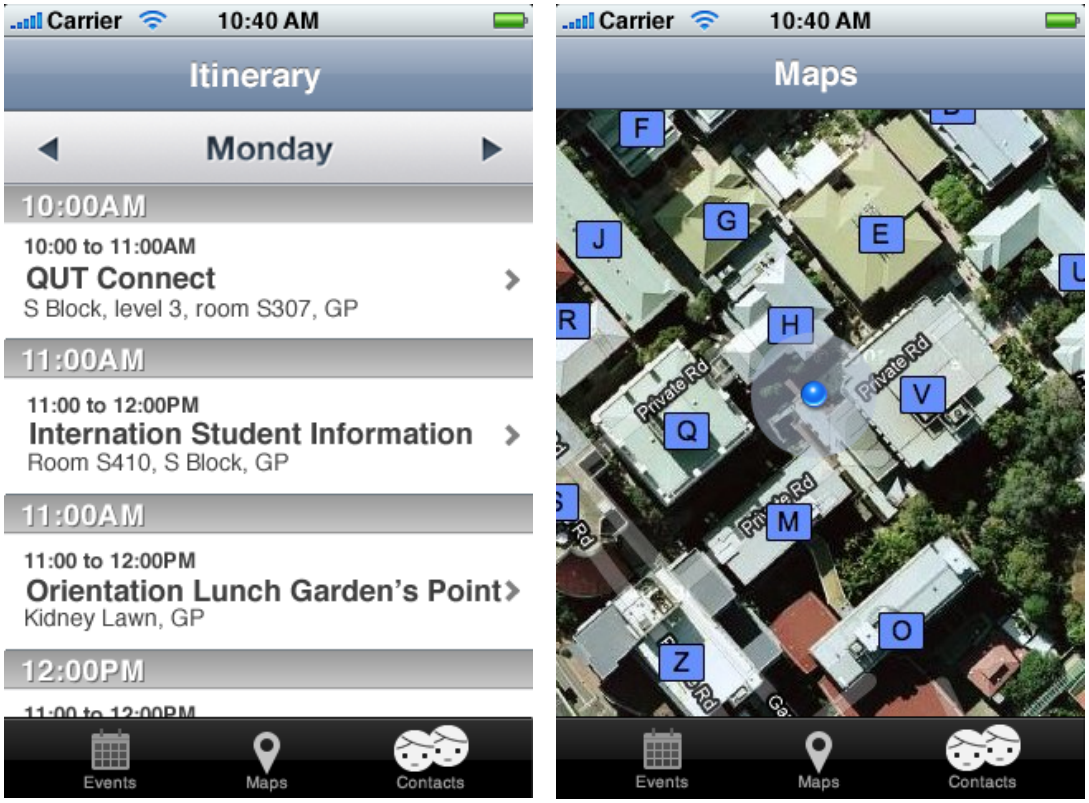

Figure 4.3 - Digital mockup of the smartphone event application

The digital mockups were presented to a second focus group of eight people from various parts of the university including the student engagement team, student and teaching support, first-year support program, science and technology and business faculty student services, and international students program. After receiving feedback, a working prototype was developed that could run on the iOS platform. Other features were added including one that allowed students to check in to events in order to mark off what they had attended, a profile page so they could edit the details they sent when adding a new friend, and an information page which provided information about orientation activities and services (see Figure 4.4).

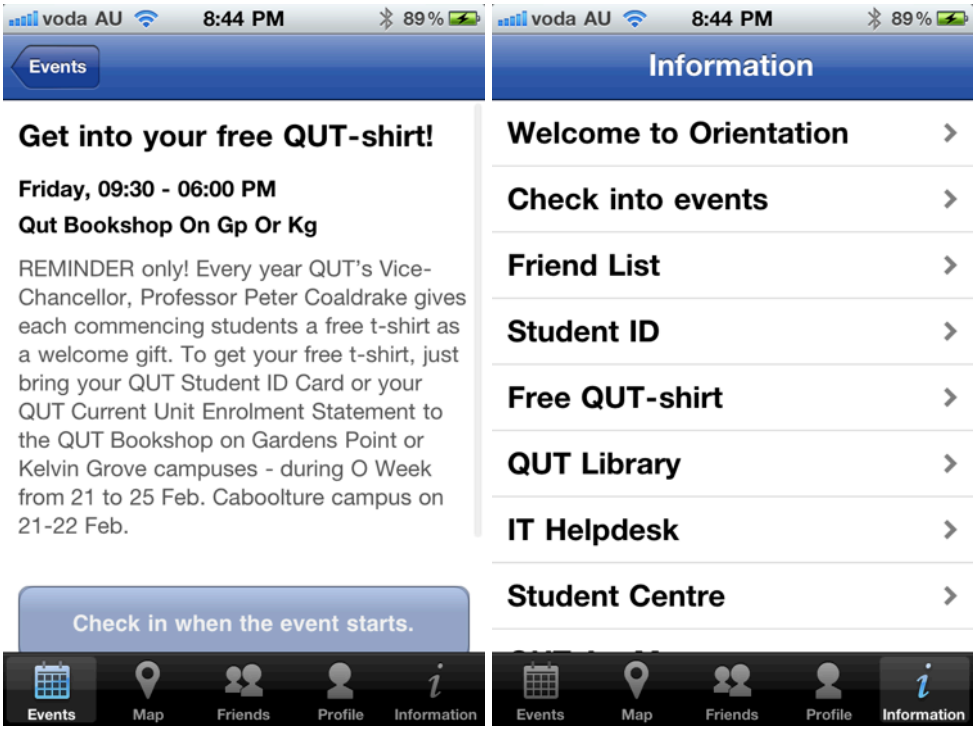

Figure 4.4 - Screenshots from the smartphone event prototype

The aim of these features was to provide functionality that supported the orientation process. Gamification was then added to further engage students with these functions, as well as with other orientation activities.

4.4 GAMIFICATION DESIGN

A gamification experience was designed for the orientation application using the three-layered gamification design framework proposed in the literature review (repeated as figure 4.5).

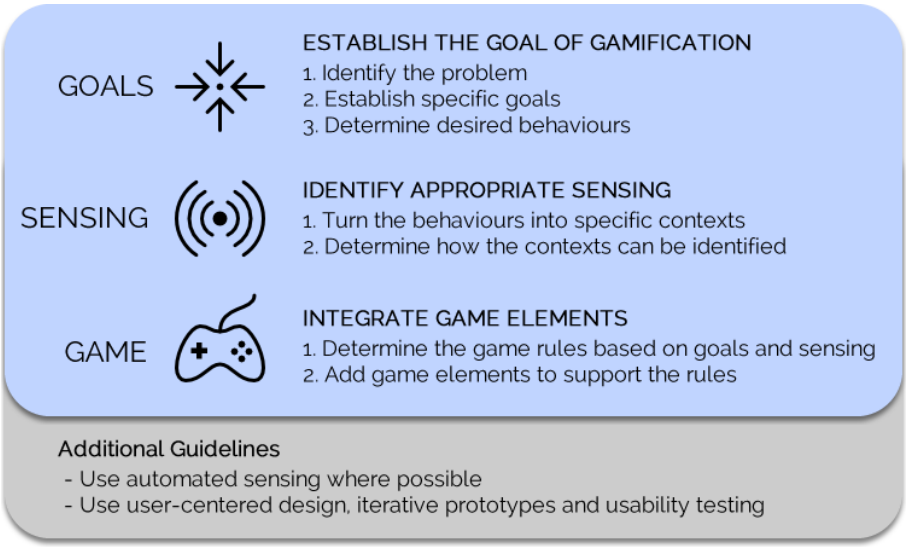

Figure 4.5 – Gamification Design Framework

4.4.1 ESTABLISH THE GOAL OF GAMIFICATION

The first step of the framework included identifying a problem, establishing specific goals for the gamification, and then determining desired user behaviour.

The problem identified in this context was to increase student engagement with the university orientation event. Based on the interviews and the focus group detailed earlier in this chapter, three high-level goals were identified for the gamification to address:

1. Encourage exploration of the campus and available services
2. Encourage participation in the orientation events and activities
3. Encourage social networking between students

Using these high-level goals, specific behaviours were then determined as key performance indicators for the goals with the help of the second focus group detailed earlier. After providing feedback on the applica-

tion prototype, the focus group then spent some time breaking down each goal into desired activities. For example, activities based on exploration included visiting important university locations (e.g., the library for borrowing books and for study spaces or the Information Technology helpdesk for help with any computer related issues), and learning about a particular university service (e.g., the university security phone number so students knew who to call in case of an emergency). Activities based on participation included attending a scheduled orientation event or collecting specific university related objects (e.g., student diary and student card). Activities based on social networking included meeting other first year students, joining a club and attending social events. Further example outputs can be found in table 4.1.

Explore campus and available services	**Participate in events and activities**	**Social Networking**
Visit the Library	Attend subscribed orientation events	Meet people from the same year
Learn the phone number for security	Attend a QUT Connect session	Meet people from the same faculty
Learn about Counselling Services	Collect ID Card	Meet people from the same degree
Visit IT Helpdesk	Collect Free T-Shirt	Learn about student support officers
Learn about campus doctors	Orientation Lunch	Attend social events
Visit Coffee Shops	Collect QUT cite|write guidebook	Learn about peer mentors
Visit the Lolly Shop	Collect Student Diaries	Join clubs, societies or a Student Association
Visit the cafeteria	Collect Orientation Bags	Learn about East West
Learn about careers	Attend Market Week	Jobs
Learn about the free campus shuttle bus	Attend a campus tour	Volunteering

Table 4.1 – Example desired activities relating to each goal

4.4.2 IDENTIFY APPROPRIATE SENSING

Once the desired behaviours were identified, the next step was to find the most automatic and accurate way in which to sense the behaviours. The gamification design framework suggested that using automatic sensing techniques should be considered first, as they provide the best way to enforce gamification elements. If automatic sensing is unable to successfully measure all the desired behaviours, then alternative crowdsourcing or self-enforcement techniques can be explored.

Suitable sensing options were chosen for each identified activity. Devices that support iOS (iPhone, iPad and iPod touch) have a range of different sensors available for use. In terms of physical sensors, location information could be accessed through the use of the phone's Global Positioning System (GPS) sensor, cellular and Wi-Fi sensors, or by scanning a Quick Response (QR) code left at a specific location using the phone's camera. Barcodes on books and other items could also be read using the phone's camera. Time could be obtained from the phone's internal clock. Movement data could be obtained from the phone's accelerometer sensor. Students could also input data using the phone's keyboard.

Virtual sensors available included a student's orientation event schedule, which provided location and time information for each event a student had signed up to attend. Other virtual sensors included a list of university related objects and their barcode numbers (e.g., books and student identification cards), a list of important university services and their details (e.g., campus security details and their phone number), a list of important places and their geographical codes, a list of locations of QR codes around the campus, and a list of contacts that the student had added to their contact list.

These sensing cues were combined in order to be able to determine when students completed the desired activities (see Table 4.2).

General Activities	Sensing cues
Provide information on a university service	Keyboard input, a list of important university services (e.g., campus security) and their details (e.g., phone number).
Scan a collected object with a barcode	Camera input, an object with a barcode (e.g., library book, student card), a list of orientation objects with barcodes and their barcode numbers.
Find a location marker on campus	Camera input, unique QR code placed at the physical, list of QR codes and their locations.
Check-in to a scheduled orientation event	Using location sensor (GPS, Wi-Fi, cellular), internal clock, event schedule with location and time information.
Meet another student	List of contacts where new contacts added using the Bump API (Bump, 2012) triggers a connection between two users when a 'bump' motion is detected at the same time (Uses location, accelerometer and time sensors).

Table 4.2 – Student activities that could be identified using available sensors

These available sensing techniques were then aligned to the specific desired behaviours for each goal. More than one sensing technique could often be used for different desired behaviours (e.g., see table 4.3).

Participation and Attendance	Sensing technique
Attend events	Check in to a scheduled orientation event
Collect ID Card	Scan the barcode of the ID card or scan the QR code placed there
Collect Free T-Shirt	Find the free t-shirt stand and scan the QR code placed there
Orientation Lunch	Check in to the lunch event or scan the QR code placed there
Collect QUT cite|write guidebook	Scan the QR code placed there or provide information regarding the book (e.g., enter the title).
Collect Student Diaries	Scan the QR code placed there or Provide information regarding the diary (e.g., enter the title).

Table 4.3 – Specific participation and attendance activities that could be identified using available sensing

These available sensed actions were then used as a basis for designing a gamification experience that support the established goals.

4.4.3 INTEGRATE GAME ELEMENTS

Once behaviours can be sensed, they can be turned into input for the game layer. Game rules can be determined that promote the desired behaviours, and other game elements can be chosen to support the experience. This may involve the addition of a range of different game design elements: for example, using graphics and narrative to set the scene, using points, levels and progress bars as feedback, or using quests, achievements and goals to create challenges.

The list of orientation activities lent itself to being presented as a list of challenges for the students to undertake while at orientation. Achievements were chosen as the primary game design element used to challenge and reward students for completing orientation activities. This research defined the video game achievement (or 'badge') as a game element that has evolved over the last decade into a very popular way to add extra challenge and play time to video games with little expense. Video game achievements are task-reward systems that usually reward the player with points, unlock bonus in-game material, or simply exist as status symbols. Achievement systems appear more and more as a means to make applications more engaging, providing goals, instruction, reputation, status and affirmation, and group identification (Antin & Churchill, 2011). The popularity of achievements that previously could be found in foursquare seemingly led to an increase of achievements being used in non-game systems.

However, some problems may arise when using achievement systems. For example, it was found that the addition of an achievement system to a geo-tagged photo sharing service, although interesting, did not convince all users of the added value; a number of them raised concerns about the achievements promoting undesirable usage patterns (Montola et al., 2009). Despite this, more and more non-game applications continue to use achievement systems. Using achievements for the

orientation application gamification provides a way to investigate their design and use in a context that has not previously been studied before.

In order to help design a suitable achievement system, a review was undertaken of previous achievement systems. Following this review an 'anatomy of an achievement' was proposed, along with a list of different types of achievements. These were created in order to aid the achievement design for this particular case study.

ACHIEVEMENT SYSTEM ANALYSIS

An analysis of achievement systems from two popular game networks was undertaken, *Steam* and *Xbox Live*, as well as two popular gamified systems, the *GiantBomb* website and *foursquare* application. The analysis provided an overview of each system, its platform availability, its statistics including release date, its active users or visits, and the number of games (if a game network). The language of the system was described and an overview and breakdown of achievement design in each system was provided, along with accompanying screenshots. An example analysis is provided below of the achievement system available in Steam. The rest of the review can be found in the appendix.

Steam Achievement System

Overview
Steam is primarily a digital game store for multiple platforms (Windows, Mac, and Linux). Steam also provides multiplayer and community tools for players, such as discussion forums, and in-game voice and chat functionality. Developers can add achievements to their games, although it is not mandatory. To complete achievements, players will often need to complete certain tasks within a game as determined by the game's developers. Users can view achievements for any game via the steam application. Global statistics can also be found that display how many other players have completed particular game achievements.

Platform: Windows, Mac, and Linux Application

Statistics:
- Initial release in 2003
- 30 million active accounts and 1200 games offered as of 19 Oct 2010 (Valve, 2010)
- Has approximately 70% of the overall digital distribution market (Graft, 2009)

Language:
- Called 'Achievements'
- Achievements that have not been completed are listed as 'locked'
- When you complete an achievement you 'Unlock' or 'earn' it.
- Achievement progress is displayed as a number and percentage of achievements earned compared to the total available.

Achievement overview:
- Players can view their friend's achievements
- Global achievements progress can be viewed, showing how many people have completed the achievements for a particular game. This is shown as a percentage of players who have earned achievements compared to all the total number of players.
  The list is ordered with the achievement completed by most play-

ers first, and the achievement completed by the least number of players last.

- Although there is no direct measure of how difficult an achievement is to complete, the global achievement progress provides some indication of this based on the number of players who have completed each achievement.
- An achievement in steam includes:
    - Title: provides an overview of the achievement, sometimes it may be amusing and not obvious what is required of the achievement just by looking at the title.
    - Image: Provides a unique image that accompanies the achievement. The image is provided by the game developer and will often link to the game aesthetic. The image can change once completed. (E.g., in the game Portal the image goes from being a grey to a black colour when completed).
    - Description: usually provides some description of what is required to complete an achievement (E.g., complete the game, jump 300 feet).
    - Progress: Some achievements require the user to repeat an activity multiple times before unlocking an achievement (E.g., For the cupcake achievement in Portal the player is required to "beat two Portal advanced maps").
    - Feedback: a popup will appear in the game when an achievement has been completed.
    - Reward: Once an achievement is completed it becomes unlocked and the game's achievement progress is updated.
- Overview: For each purchased game there is an achievements section which can be viewed. This shares with the player the most recent achievement they have completed or are progressing towards achieving, the total number of achievements completed in the game as a number and a percentage, a progress bar representing the completed achievements visually, a list of locked achievements and a button that links the player to a page with a list of all the achievements for the game.

ANATOMY OF AN ACHIEVEMENT

Based on the achievement system analysis, an anatomy of a typical achievement is proposed in order to help design achievements for other games or applications:

- Title: Name of the achievement.
- Description: What activity the player needs to satisfy in order to complete the achievement.
- Unlocked text: Additional text may be presented when an achievement is completed (e.g., in *foursquare* when the "newbie" badge is unlocked the text "Congrats on your first check-in!" is presented).
- Progress: If an achievement requires multiple activities to satisfy its completion then the progress towards completion can be shown.
- Icon: A visual representation of the achievement.
- Difficulty: How difficult the achievement is to complete (this may or may not be hidden from the player and may be fairly abstract).
- Value: Different achievements may have different values or points. The value of an achievement may be based on how difficult the achievement is to complete. For example, each *Xbox 360* game has 1000 points available that can be obtained by completing all the achievements but each achievement may have a different value as specified by the game developer.
- Feedback: Often once an achievement is completed some feedback will be provided to the player. This is often in the form of discrete popup while player the game or using the application or can be more obvious.
- Set: Some achievements may be related to other achievements in the game. For example, in the game *Portal* three related achievements include:
    - Basic Science: Earn bronze medals on all *Portal* challenges.
    - Rocket Science: Earn silver medals on all *Portal* challenges.
    - Aperture Science: Earn gold medals on all *Portal* challenges.

In addition to these elements an achievement system is also likely to provide an overview total achievement progress as a number, percent-

age or progress bar. An achievement system may also offer the ability to be seen by other players or users, or shared via social networks. Achievements will often range in terms of difficulty to complete. It is common to find very easy achievements being included in order to motivate the player. For example, in *foursquare* the user receives a badge for their very first check-in. This rewards them for checking-in and aims to encourage them to continue using the service to earn more badges. However, achievements are then likely to become more difficult, in order to make completing them more challenging over time.

A list of different types of achievements was also created. Note that this list is not exhaustive and that an achievement may have one or more of these achievement types. The list of achievement types include:

- *Gameplay achievements:* Achievements that will be completed simply by playing the game or using the application (e.g., In *Portal* there is an achievement for finishing the game or in *foursquare* there is an achievement for checking-in).
- *Optional achievements:* Achieved by undertaking activities that are not necessary to complete the game or using the application (e.g., In *Portal* there is an achievement for knocking all the cameras off the walls or in *foursquare* there is an achievement for checking-in on a boat).
- *Unknown Achievement:* An achievement that is hidden from the player or the description is hidden. The achievement is not shown completely until it is unlocked, or the requirements for accomplishing the achievement are not shown (e.g., In *Portal* an achievement "*Received Transmission*" has the description: "*???*").
- *Humorous Achievements:* Depending on the type of game or application, a humorous title or description may be used in order to joke with the player or user.
- *Unique Achievement*: only one person can have the achievement at one time (e.g., Mayorship in Foursquare may be seen as an achievement, but only one person can have for any one location).

- *Sub-achievements:* achievements that are part of a larger group of related achievements. Sometimes multiple achievements need to be completed in order to complete a set of achievements.
- *Positive achievements:* rewarded for actions that are seen as beneficial to gameplay or rewarding skill.
- *Negative achievements:* awarded for failing or not completing something correctly (e.g., in the game *Dead or Alive 4*, there are several negative achievements for losing 5, 10 and 20 consecutive online matches).

The analysis, achievement anatomy, and feature list provides a starting point from which achievements can be designed for orientation.

4.4.4 DESIGNING ACHIEVEMENTS FOR ORIENTATION

Combining the anatomy and achievement types with the categories from Montola et al. (2010) provides a useful set of tools with which achievements can be designed. Achievement challenges were first created by picking a goal, choosing a desired behaviour and designing an achievement for it using available sensing techniques (see table 4.4).

Goal →	**Desired Behaviour →**	**Achievement Objective**
Encourage exploration of the campus and services available	Learn about the free campus shuttle bus	Find out the bus number of the campus shuttle bus and enter it
	Visit the library	Find the library and scan the QR code there
Encourage participation in the orientation events	Attend a scheduled orientation event	Check-in to one scheduled event
	Collect your student ID card	Scan the barcode on your student ID card
Encourage students to meet other students	Meet people from the same year	Add your first contact to the contact list from the same year

Table 4.4 – Examples of creating objectives using desired behaviours

A list of achievement objectives was created, then each objective was developed. Clues, images and unlocked text were added to each achievement, and all of the achievements were organised into different sets that focused on different orientation goals. Examples for two achievements from two different sets are shown in Table 4.5.

Details	Achievement One Example	Achievement Two Example
Set	Event Manager (Participate)	Campus and Services (Explore)
Title	Roll call	Hail to the bus driver.
Image		
Clue	Check-in to your first event	We're looking for the three-digit route number of the inter-campus bus; enter it to unlock this achievement.
Trigger	Events attended = 1	Number entry = 391
Description	Alright! You're off to a good start! Attending events is essential to getting the most out of QUT Orientation. The events page will help you keep track of upcoming events and events you've attended. This feature only works if you're at the right place at the right time so don't forget to check in!	Need a lift to the other campus? Never fear, the university provides a free shuttle bus service to assist students and staff travelling between the each campus for the purpose of attending lectures or attending to University business. The service is operated for the University by TransLink. University staff and students are able to travel free but will need to show the driver their university identity card.

Table 4.5 - Two examples of achievements presented in the application

Consideration was given to the experience of the entire achievement system. Immediate feedback was provided to the user by presenting an alert message whenever an achievement was completed. Similar to

many achievement systems in the review, users were introduced to the system through easy, introductory achievements. To make the achievement system more challenging over time, achievements became progressively harder to complete, either by requiring more activities to be undertaken (e.g., "attend your third event"), by providing location hints instead of giving exact location (e.g., "this place will fulfill all your sugary desires"), or by having cryptic clues (e.g., "025.344 15" where in this case this number is a catalog code requiring the student to scan a book in the library). A difficulty matrix was created in order to aid in designing achievements with different difficulties (see Table 4.6).

Achievement Challenge Matrix	**Easy Locating** Challenge location is provided.	**Hard Locating** Challenge location is hinted at.
Easy Clue No deciphering needed, information is provided.	Easy Achievement	Medium Achievement
Hard Clue Deciphering needed, some other information is needed	Medium Achievement	Hard Achievement

Table 4.6 - Difficulty matrix used to design achievements for orientation

A total of 20 achievements were created and these were integrated into the orientation application. A separate view was added with a list of the available achievements, sorted into sets. Users could tap on an achievement to view the hint and attempt to complete it if it required active input (e.g., scanning a QR code). Once complete, an achievement would reveal its unlocked text and also the achievement image.

4.4.5 USABILITY STUDY

A usability study was undertaken with four university students to make sure the application was usable. This evaluation tested both technical and usability aspects of the application in a laboratory setting. The

users were introduced to the application and had to complete five simulated challenges based on the different sensor inputs being used. Observations were made while they were using the application and the researcher noted any usability problems. Users then used the application freely and provided feedback on their experience while the researcher took notes. The feedback identified a number of bugs and possible improvements. A number of design problems, suggestions and general comments were also provided and based on these results the design of the application was adjusted to accommodate. These changes included making buttons easier to click, removing unnecessary buttons and updating some text to make various functions easier to understand.

It was also suggested that levels or ranks could be included in order to provide more motivation for users. From this particular suggestion, five ranks were created, ranging from "Orientation Newbie" to "Orientation Master", with each consecutive level requiring more achievements to be completed in order to unlock it:

- Level 1 – Orientation Trainee (Starting level)
- Level 2 – Orientation Apprentice (2 achievements to unlock)
- Level 3 – Orientation Orienteer (5 achievements to unlock)
- Level 4 – Orientation Expert (9 achievements to unlock)
- Level 5 – Orientation Master (15 achievements to unlock)

These levels were used to provide further motivation for users to complete the achievements. Also, when a student shared their contact information with another student they also shared the number of achievements they had completed. This aimed to encourage friendly competition between students.

4.4.6 FINAL PROTOTYPE DESIGN FOR THE FIELD EXPERIMENT

After the changes were made based on the feedback, the gamified application was finalised and ready to be evaluated in a field study. The final gamified application included an event list, a map, a friend list, a profile and a list of achievements. The non-gamified application had all but the list of achievements and the references to levels or achievements in the profile page.

EVENT LIST

The event list provided a personalised list of orientation events for new students. Students could view their schedule for the week, along with detailed information about each event. Students could check-in to each event, but only if they were on campus at the time of the event.

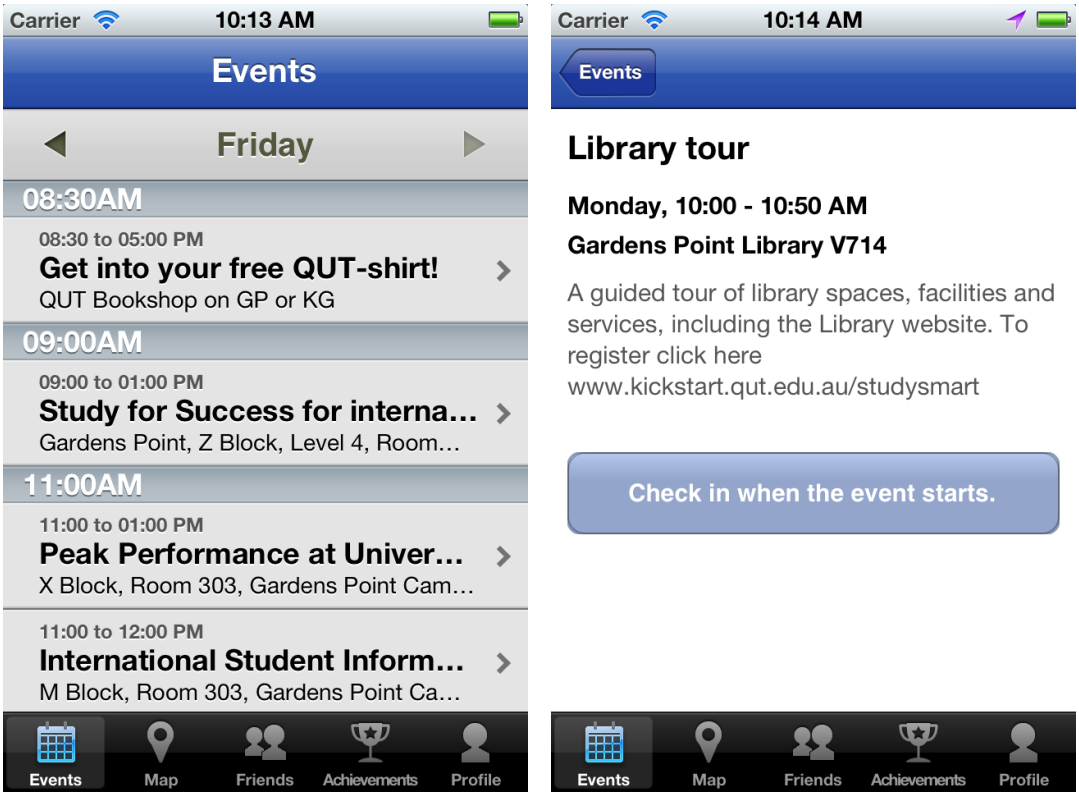

Figure 4.6 - Event list and event details view

MAP VIEW

The map provided students with an overview of all the buildings on campus. To help them navigate, it also showed the student their current location.

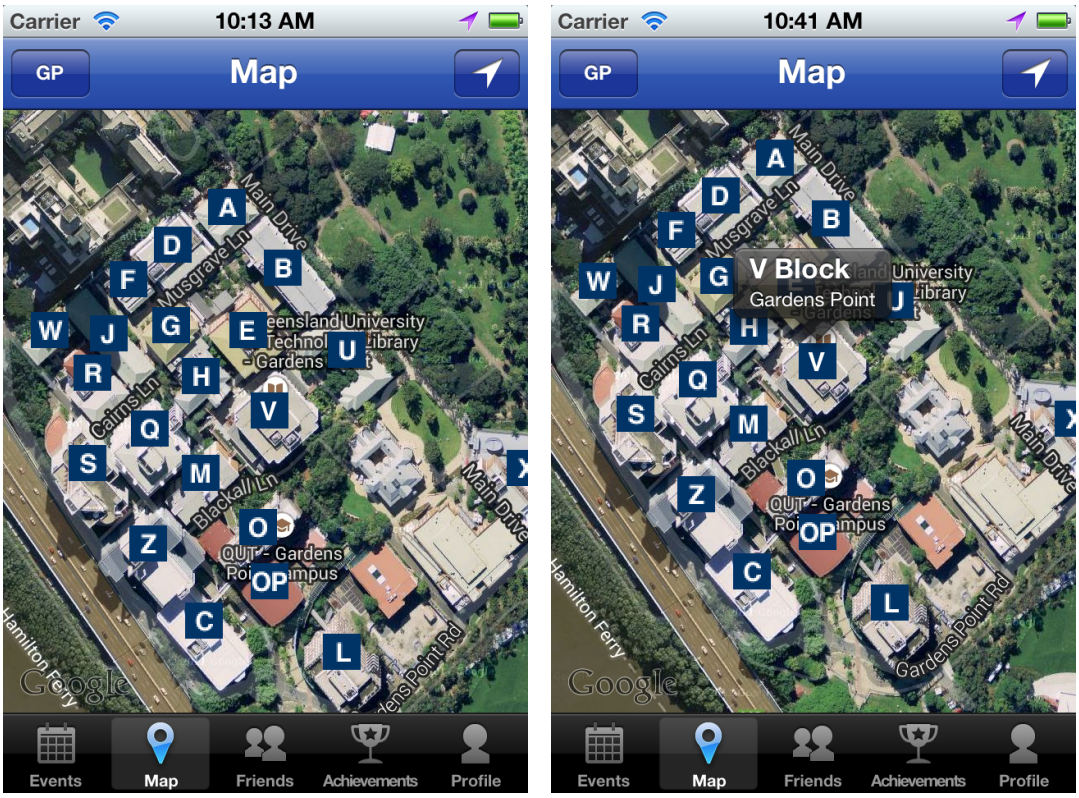

Figure 4.7 - Map view

FRIEND LIST

The friend list allowed students to easily add contact details of any new friends they made on campus. Students simply pressed the *Add* button and then 'bumped' phones together with another student to share contact details. This used the Bump API to connect phones, a free tool that allowed two phones to connect when they were physically bumped together. After establishing a connection between devices, both applications shared student contact information, university course information, and the number of achievements completed between students.

Figure 4.8 - Friends list and friend detail view

PROFILE VIEW

The profile view provided the student with application usage statistics, including the current level of the user, the number of achievements they had unlocked, the number of challenges they needed to complete until they reach the next level, the number of friends they had added, and the number of events they had attended. Students could also edit their profile details, limiting the information they shared with other students when bumping phones.

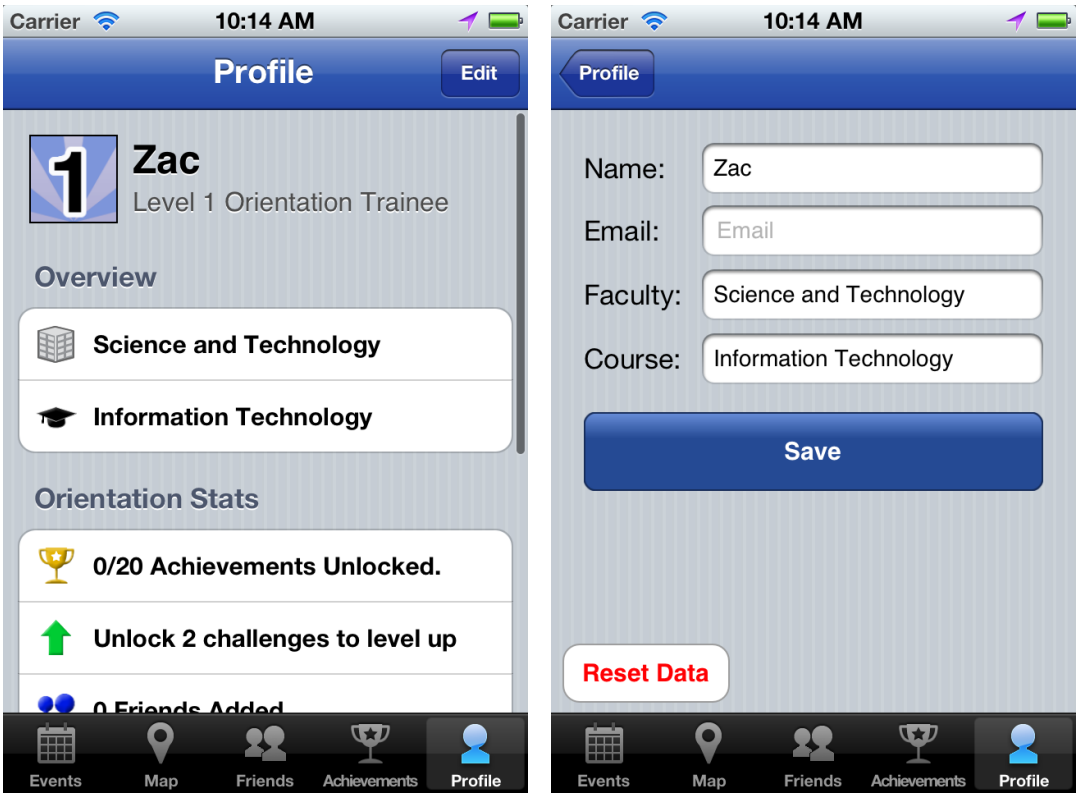

Figure 4.9 - Profile overview and details view

ACHIEVEMENTS LIST

The achievements list provided a list of achievements the student could complete while at university orientation. The achievements were organised into a number of different sets, each with a different theme. Clicking on an achievement revealed detailed information about it, such as a clue that hinted at how to complete the achievement and an action button if the achievement required active input (e.g., scanning a QR code or barcode).

When an achievement was completed, an image was revealed as a reward, along with unlocked text congratulating the user and providing extra information for them to read.

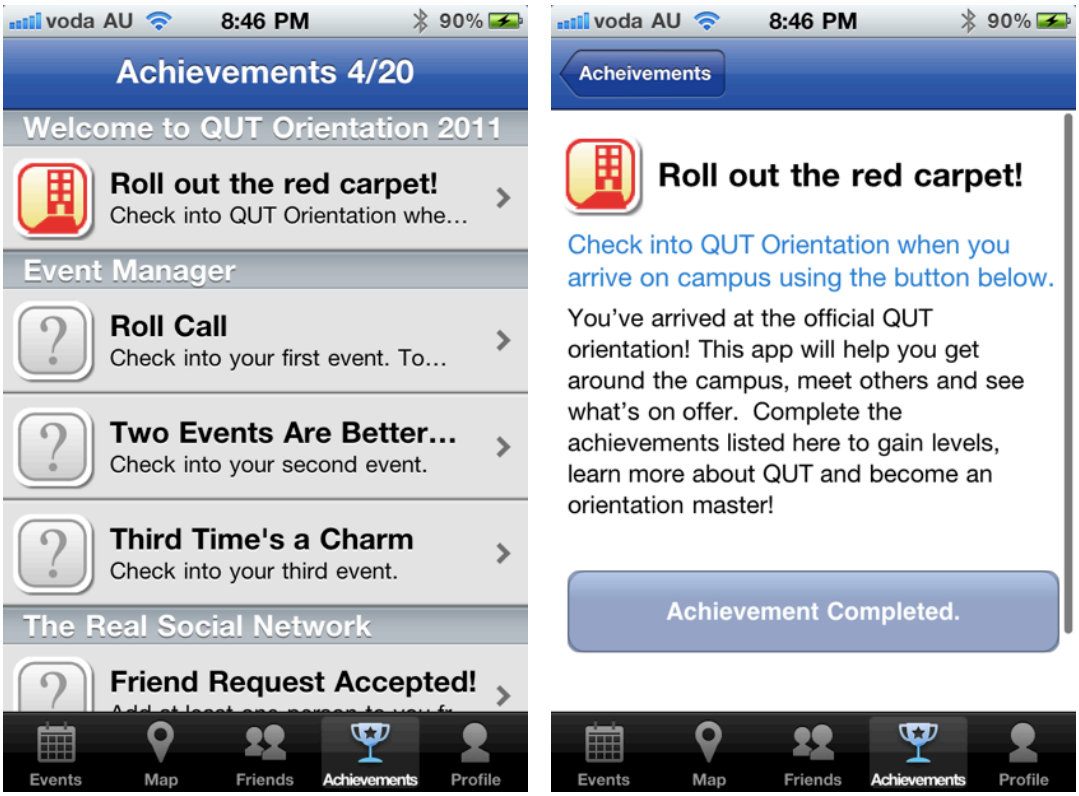

Figure 4.10 - Achievement list with details of the first achievement

4.5 CHAPTER SUMMARY

This chapter provided an overview of the design of a gamified mobile application for new university students attending orientation. The gamification design framework proposed in chapter two was used to design the experience, along with the results of an analysis of current achievement systems. An iterative design process was used, where feedback was gathered from a focus group and a usability test in order to improve the gamification design. The finalised prototype will be evaluated in the next chapter using a field study.

5. EVALUATING THE ORIENTATION GAMIFICATION DESIGN

To investigate the usefulness of the initial framework, a field study was undertaken to evaluate the resulting gamification design. A total of 46 new students were recruited to trial either a gamified version of the application, or a non-gamified version. Participants used their application during the day and then returned to provide feedback on their experience. This chapter presents the findings of the study and discusses the effectiveness of the design and framework.

5.1 FIELD STUDY OVERVIEW

The aim of the field study was to evaluate the effect the achievement system had on user experience, motivation and behaviour change. The study also investigated the reception of the added gamification. Three hypotheses were formed:

1. We predict that participants using the gamified application will have a more positive user experience compared to participants using the non-gamified application.
2. We predict that participants using the gamified application will feel more motivated compared to participants using the non-gamified application.
3. We predict that the gamified application will encourage more behaviour change compared to the non-gamified application.

In addition to these three hypotheses, a research question was also investigated:

1. Is the addition of game elements well received by university students?

To measure the constructs, usage data was captured during the field study and a questionnaire was administered to participants at the end of the field study.

Figure 5.1 – A student using the application at orientation

5.2 FIELD EXPERIMENT RESULTS

An analysis was undertaken on the data captured using SPSS and the following results were obtained.

5.2.1 PARTICIPANT DEMOGRAPHICS

A total of 46 new students were recruited to participate in the field study (male = 31, female = 15). Their ages ranged from 17 to 45 (mean = 20.76, SD = 5.824). Of the total, 26 students used the gamified application during orientation week; the remaining 20 used a non-gamified prototype (control).

All of the participants were new to university, but had visited the campus about twice before they attended orientation (mean = 2.24, SD = 0.899). The participants were entering their first year in one of seven different university faculties (see Table 5.1). Most students were from the Business, Built Engineering and Environment, or Science and Technology Faculty.

Primary University Faculty	Frequency	Percent
Built Engineering and Environment	14	30.4
Business	16	34.8
Creative Industries	1	2.2
Education	1	2.2
Health	2	4.3
Law	1	2.2
Science and Technology	11	23.9
Total	**46**	**100.0**

Table 5.1 – An overview of represented university faculties

SMARTPHONE AND VIDEOGAME USAGE

Participants had been using an iOS device for anywhere between 0 to 44 months (mean = 12.5 months, SD = 10.893). Reported iPhone usage varied from 5 minutes to 2 hours a day. Reported video game usage varied widely, with participants reporting that on average they played video games for 4.70 hours a week (SD = 7.738) and mobile games for 3.89 hours (SD = 4.667). Twenty-three of the participants had used a video game achievement system before. All but one of these participants reported that they enjoyed using that particular system. Only one participant had used an achievement system in a non-game application (foursquare). This participant reported an enjoyable experience with this achievement system.

INDEPENDENT GROUP DIFFERENCES

Participants were randomly divided into two independent groups to trial different versions of the iOS orientation application, with 26 participants trying the gamified application and 20 participants trying the non-gamified application. An independent t-test after the study found no statistical difference ($p > 0.05$) between the two groups in terms of age, previous number of campus visits, months using a smartphone, hours a day using a smartphone, hours a week playing games and hours a week playing mobile games.

5.2.2 USER EXPERIENCE RESULTS

The following results compare both versions of the application in terms of user experience. In addition to a user experience scale, individual aspects of user experience are also looked at, including usefulness, ease of use, aesthetics, and user enjoyment.

User Experience Measures	Gamified Version (n=26)	Non-gamified version (n=20)	*U*	*z*	*p*
User Experience Scale	4.50	4.50	247.5	-.283	.777
General Usefulness	4.00	4.00	245.5	-.366	.714
Event list Usefulness	4.00	4.50	229.0	.726	.468
Check-in usefulness	3.00	3.00	277.5	.400	.689
Friend view usefulness	3.00	3.00	307.0,	1.081	.280
Bump usefulness	4.00	3.00	345.5	1.965	**.049**
Campus map usefulness	5.00	4.00	350.5	2.168	**.030**
Current location usefulness	5.00	5.00	279.0	.478	.633

Table 5.2 – Median User Experience and Usefulness Scores for Gamified and Non-Gamified Versions

A Mann-Whitney U test was run to determine if there were differences in user experience between participants who used the gamified version and participants who used the non-gamified version. The median user experience score was not significantly different between the two different groups. It is interesting to note that the bump and campus map were the only two features that were considered more useful in the gamified version.

APPLICATION USEFULNESS

A Mann-Whitney U test was run to determine if there was a difference in the application usefulness score between participants who used the gamified and non-gamified applications. The median usefulness scores for non-gamified participants (4.0) and gamified participants (4.0) were not significantly different, indicating that participants found both applications equally useful.

Additional Mann-Whitney U tests were run to determine if there were differences in the usefulness of various features between participants who used the gamified and non-gamified applications. For the usefulness of the events list view, the median scores for participants using the non-gamified application (4.5) and gamified application (4.0) were not significantly different. For the usefulness of the check-in to an event function, the median scores for participants using the non-gamified application (3.0) and gamified application (3.0) were not significantly different.

For the usefulness of the friend view the median scores for participants using the non-gamified application (3.0) and gamified application (3.0) were not significantly different. For the usefulness of the bump phones to add a friend feature, the median engagement scores for participants using the non-gamified application (3.0) and gamified application (4.0) were significantly different. This suggests that those who using the gamified application found the bump feature to be more useful than those who used the non-gamified application.

For the usefulness of campus map view, the median scores for participants using the non-gamified application (4.0) and gamified application (5.0) was significantly different. This suggests that those who used the gamified application may have found the campus map more useful than those who used the non-gamified version. For the usefulness of the current location feature, the median scores for participants using the non-gamified application (5.0) and gamified participants (5.0) were not significantly different. Note that both median values for each group were high.

5.2.3 MOTIVATION AND BEHAVIOUR CHANGE RESULTS

Application usage data was successfully captured from only 13 participants who used the non-gamified application and from 22 participants who used the gamified application. The missing data resulted from participants who did not already have their email client set up on their device (predominantly users of iPod touch devices). None of our key outcome measures were expected to relate to the type of device used, and hence, this issue is unlikely to have introduced any systematic bias. Using the available data, a comparison was made to see if any differences occurred. Both versions of the application captured the number of events each participant checked in to, as well as the number of friends added to the friend list.

Motivation Measures	**Gamified Version (n=26)**	**Non-gamified version (n=20)**	***u***	***z***	***p***
Perceived Motivation Scale	3.944	3.944	254.5	-.122	.903
Behaviour change measures	**Gamified Version (n=22)**	**Non-gamified version (n=13)**	***u***	***z***	***p***
Number of Check-ins	3.00	0.00	207.5	.023	.026
Number of Friends added	1.00	0.00	217.0	.007	.011

Table 5.3 – Median Motivation and Behaviour Change Scores for Gamified and non-Gamified Versions

PERCEIVED MOTIVATION SCALE

A Mann-Whitney U test was run to determine if there were differences in perceived motivation between participants who used the gamified version and participants who used the non-gamified version. The median perceived engagement score was not statistically significantly different between the two groups.

NUMBER OF EVENT CHECK-INS

A Mann-Whitney U test was run to determine if there were differences in the number of event check-ins between participants who used the gamified version and participants who used the non-gamified version. The median number of check-ins was statistically significantly different between the two groups (with more check-ins completed by participants using the gamified version). For those using the gamified version, it was found that both the mode and the median number of event check-ins were three – the same required for the final event-related achievement.

Participants who used the gamified version answered an additional Likert-type question that asked them if the achievement system motivated them to attend events. The median response (n = 24) for this question was 3.5 (between the "*Neither Agree nor Disagree*" and "*Agree*" responses) and the mode was 3 ("*Neither Agree nor Disagree"*).

NUMBER OF FRIENDS ADDED

A Mann-Whitney U test was run to determine if there were differences in the number of friends added to the friend list between participants who used the gamified version and participants who used the non-gamified version. The median number of friends added was statistically significantly different between the two groups (more friends were added by participants using the gamified version). However, the average number of friends added was not particularly high in the gamified version (1.54, SD = 1.103).

Participants who used the gamified version answered an additional Likert-type question that asked them if the achievement system motivated them to add friends. Both the median and the modal responses (N=24) for this question were 4.0 ("Agree").

CAMPUS AND SERVICE ENGAGEMENT

An additional Likert-type question asked participants who used the gamified application if the achievement system motivated them to ex-

plore the campus. The median and modal response (N=24) for this question was 4.0 ("Agree"). Short answer responses regarding exploration-related achievements were positive, with participants saying that these types of achievements *"made me want to find where things are"*, *"led me to places I enjoyed and that I otherwise wouldn't have seen"*, and that they *"were the most motivating part of the application, it caused me to walk all around the university."*

VALUE ADDED TO THE EVENT BY THE APPLICATION

An independent-samples t-test was run to determine if there were differences in reported value added to the orientation experience between the two groups. The mean reported value added for non-gamified participants (4.50, SD = 0.478) and gamified participants (4.36, SD = 0.399) was not significantly different, $t(44) = 1.091$, $p = 0.281$. Note that both mean values for each group were relatively high.

An additional Likert-type question asked participants who used the gamified version if they thought the achievement system added value to the orientation experience. Both the median and the modal responses (N=24) for this question were 5.0 ("Strongly Agree").

5.2.4 GAMIFICATION EXPERIENCE RESULTS

Those who tried the gamified version of the application (N=26) answered a number of additional survey questions related to their subjective experience of the achievement system.

Statistics	Fun to use (N = 26)	Attractive design (N = 26)	Easy to understand and use (N = 26)
Median	Strongly agree	Agree	Strongly agree
Mode	Strongly agree	Agree	Strongly agree

Table 5.4 – Gamification experience results from achievement system users

GAMIFICATION ENJOYMENT

A Likert-type question asked participants if they found the achievement system fun to use. Both the median and the modal responses (N=24) for this question were 5.0 ("Strongly Agree"). All but one participant reported that the difficulty level of the achievements was appropriate. A multiple-choice question asked participants to record which type of achievement they preferred to complete and of the five available options (adding a friend, answering a numerical question, checking into a location, checking into an event, or scanning a QR code) the most popular was 'scanning a QR code' (12 responses).

Participants reported in short answer responses that the achievements were "*such a fantastic twist*" and "*were genuinely fun*", "*great for killing time productively", "very fun*" and that "*unlocking the achievements made it [the application] interesting*". Participants also reported that they liked the integration of achievements with orientation activities "*because it was simple and part of existing activities*" and because they were "*based on existing activities*" at orientation. Participants also reported that the QR codes could be difficult to find at times because they were not sure if some QR codes were related to the game, or if they were for some other purpose (some advertisements and other applications use QR codes).

Participants were asked to pick their favourite and least favourite individual achievement. The responses varied widely; some students liked the 'card games' achievement that required students to collect their student identification card and scan it. They said this achievement was "*easy and fun",* and *"made it fun"*. However, others did not like this achievement at all, noting that they found it "*pointless*". Some participants really liked the challenging achievements. For example the 'Game On!' achievement was very hard to complete, but participants said, *"I couldn't figure it out, but it was cool that there was a mystery achievement",* and *"it was genuinely challenging/satisfying to complete"*. However, some students found this frustrating, saying it was also *"pointless"*. A number of participants did not like achievements that required numerical input (e.g., 'Book Worm' and 'Center of Attention') because they could simply "*guess the answer through trial and error".*

GAMIFICATION AESTHETICS

A Likert-type question asked participants if the achievement system was attractive. Both the median and the modal responses (N=24) for this question were 4.0 (“Agree”).

GAMIFICATION EASE OF USE

A Likert-type question asked participants if the achievement system was easy to understand and use. Both the median and the modal responses (N=24) for this question were 5.0 (“Strongly Agree”).

GAMIFICATION ENGAGEMENT

Application usage data was captured from 24 participants who used the gamified application. Every participant completed at least one achievement. Of an available 20 achievements, the mean number completed by participants was 12.88 achievements (SD = 4.504). The mode and mean results were both 14. One participant managed to complete all 20 achievements.

Some participants reported that they cheated when completing some achievements. For achievements that required numerical input (e.g., finding how many levels a building had, or entering the university bus number), some participants reported that they could simply guess the answer. It was also found that because of the large radius compensating for the GPS location sensor limitations, two students admitted they checked in to events that they did not actually attend just to unlock the achievements.

GAME ELEMENTS THAT MOTIVATED PARTICIPANTS

A multiple-choice question asked participants who used the gamified application to suggest the most motivating aspect of the achievement system. Of the five available options (completing all the achievements, collecting points, gaining levels, competing with others, or working with others) the three most popular responses were ‘completing all the

achievements' (10 responses), 'gaining levels' (10 responses) and 'competing with others' (3 responses).

Another multiple-choice question asked the same participants to record what additional elements may have motivated them to complete more achievements. Of the four available options (More competitive elements, time limit to complete achievements within, more game elements, or a physical reward) the most popular response was a 'physical reward' (11 responses), followed by 'more competitive elements' (9 responses).

5.2.5 SUMMARY OF RESULTS

Results suggest that adding an achievement system to the orientation application did not positively or negatively affect the user experience. Although there was no effect on perceived motivation found, results suggest that the gamified version did encourage participants to check in to more events and add more friends. The gamification design was well received by those who used it and participants were fairly engaged with it, completing on average 12.88 achievements.

5.3 DISCUSSION

It was hypothesised that adding an achievement system would enhance user experience, perceived motivation and behaviour change. However, results suggest that adding an achievement system did not significantly affect the user experience or perceived motivation. Although behaviour change was recorded, some cheating did occur as well. The gamification experience was nonetheless positive and participants were willing to complete a number of achievements. By completing achievements these participants were being exposed to university information in a fun way. These results suggest that although the addition of an achievement system did not have a negative impact, it did not have a significant positive impact either. This indicates that the gamification design framework was useful but there are additional factors that may need to be considered when designing gamification in the future.

Further refinements are needed to the gamification design framework to justify its use; otherwise the addition of gamification in contexts such as these may be superfluous.

5.3.1 THERE WAS LITTLE EFFECT ON THE USER EXPERIENCE

As noted, the results suggest that adding an achievement system to the orientation application did not enhance the user experience. However, at the same time it did not negatively affect the user experience either.

It was hypothesised that the addition of game elements would enhance the user's experience. However, there was no significant difference in reported user experience between the two groups of participants. The novelty factor of both versions of the application may have contributed to this, compared to the paper event planner that participants would have received. Mean responses for both groups were high, suggesting that a ceiling effect may have occurred, thus making it difficult to compare the two groups. It may be useful to use a different or additional measure of enjoyment in the future to help clarify this result.

It is worthwhile noting that some functions of the application were reported to be more useful by participants using the gamified version, such as the campus map and the ability to bump phones to add new contacts. This may have been because the map feature helped participants complete the achievements and bumping phones was also necessary to complete some of the social achievements.

5.3.2 THERE WAS SOME RECORDED BEHAVIOUR CHANGE

It was hypothesised that the addition of the achievement system would increase motivation and affect behaviour at orientation, encouraging participants to check in to more events, add new people to their friend list and explore the campus. There was no difference in reported subjective motivation between the two groups. However, results suggest that participants using the gamified version did use some features of the application more than those using the non-gamified application. This suggests that the achievements encouraged participants to check in to

more events and add more people. However, this behaviour change generally ceased once the related achievements were completed.

It was found that, on average, participants who used the gamified application completed more than half of the achievements available. This indicates that participants were motivated to complete some of the achievements, which meant they were being exposed to university information. However, whether this exposure meant that participants learnt something about the university or not cannot be deduced from the results of this study.

The results suggest that participants who used the gamified version used the check-in and add friend functions of the application more than those using the non-gamified version. This is likely to have occurred because some achievements required the use of these functions in order to complete them. For example, an achievement was awarded to participants who checked into three events. However, the majority of participants stopped using the check-in function once this achievement was completed. This suggests that adding achievements motivated participants, but after they were completed the function lost its value. More achievements could be added to encourage further use, but this does not guarantee that adding more of the same achievements would continue to engage users or encourage long-term behaviour change.

Two participants admitted to cheating by checking-in to events they did not attend. Event-related achievements made up three of the 20 available achievements. This may have affected the check-in results, thus affecting the behaviour change results. Previous studies have had issues when trying to accurately position users using technology (Benford et al., 2004; Schwabe & Göth, 2005). Although technology has advanced since then, the GPS sensor used by this application had accuracy issues, especially when used indoors. To counteract this, the application increased the location radius required for participants to check in to events, enabling users within 1000m could check in to an event. Some users found that they could exploit this and check in to events without having to attend them, thus unlocking related achievements.

For this particular case, alternative sensing options, such as placing QR codes at locations instead could be used instead of relying on the GPS sensor. Otherwise the event check-in achievements could be removed altogether. It is worthwhile noting that cheating has been an issue identified in other studies as well (Singer & Schneider, 2012; Toscos et al., 2006; Xu et al., 2012) and needs to be considered further when designing gamification.

5.3.3 THE GAMIFICATION EXPERIENCE WAS POSITIVE

The majority of the participants who used the gamified application reported that it was fun to use, aesthetically pleasing, and easy to understand and to use. It was interesting to note that different player preferences emerged. Some design issues emerged that should be considered in future implementations. The majority of those who used the gamified application reported that it was fun to use, attractive, and easy to use. These findings are similar to those from Schwabe and Göth (2005), who reported that most players considered their application fun as well. Montola et al. (2009) found that adding achievements to a mobile application led to some users being confused by them. The results of our study found no confused users; however, this could have been due to the detailed application introduction each participant received before undertaking the study. Montola et al. (2009) state that the user guide they provided to the participants explained the achievements only very briefly and that this open-ended simplicity was a central cause of confusion. The group of confused participants from their study did not understand why they were collecting points when no prize was given (Montola et al., 2009).

When Montola et al. (2009) studied the effect of achievements on user experience they also found that three different user groups emerged: those who appreciated the achievements, those who did not, and those who were confused by them. These three groups did not appear in this study. This could have been because of the demographical difference of participants in the two studies, or because participants were given a detailed introduction to the application before they used it. Although these groups did not emerge in the orientation field study, it was found

that different participants preferred different achievements. Some participants liked challenging achievements, while others preferred simple achievements. Some participants enjoyed achievements that supported orientation tasks, while others thought these were pointless. This indicates that there were different player preferences amongst participants, and these should be taken into consideration when designing gamification experiences. Previous research has investigated different player types in different genres of games (e.g., Bartle, 1996), interested in determining what different types of players want from games. Similarly, the design of gamification may benefit from considering different needs and interests of players during the design process.

Participants generally preferred game activities that required some kind of real-world interaction or input to complete, compared to those that simply required answering a numerical question. Out of the five different types of user actions – check in to a location, check in to an event, add a friend, scan a QR code and answer a question – half of the students picked 'scanning a QR code' as their favourite type of action to complete. On the other hand, a number of participants reported that for achievements that required numerical input (e.g., finding how many levels a building had or entering the university bus number) they could simply *"guess the answer through trial and error*". This ability to guess the answer meant that a number of students thought this activity was *"useful but not fun"*. This suggests that designing challenging and fun game activities is important.

It was found that very few participants completed achievements that required them to add friends to their contact list. This is likely to have occurred because these achievements required participants to 'bump' phones with each other. This meant that only participants in the study could add friends, thus reducing the usefulness of this feature until more students had access to the application. Allowing participants to add friends without having to bump phones may have been more useful. However, this may have led to more cheating if participants could simply enter a contact manually in order to complete an achievement. This balance between usability and enjoyment was overlooked during the gamification design but should be considered further in future dur-

ing the design process. In hindsight, one solution to address this issue would be to unlock friend-based achievements only when the bump feature is used, but leave it so that contacts could be added manually at any time.

5.3.4 EFFECTIVENESS OF THE INITIAL FRAMEWORK

The initial framework provided a useful foundation for designing a gamification experience. The results of this study suggest that the achievements designed for the application were somewhat effective – they did not negatively affect the user experience, and they encouraged the use of some application functions. However, results also suggest that there are a number of additional areas that need consideration when designing gamification.

The results also suggest that designing challenging and fun game activities is important, as simple game activities were not enjoyed as much by participants when compared to the more challenging ones. The potential for players to cheat needs to be considered, along with other gamification problems, and steps should be added to the framework to help minimise these problems. The balance between usability of the tool and enjoyment of the gamification needs consideration too. This suggests that playtesting could be a worthwhile undertaking in addition to usability testing to help find issues like this with the player experience.

The results found that although the achievements encouraged checking in to events, this activity generally stopped after the related achievements were complete. This indicates that participants were only motivated to undertake the activity because of the achievements, i.e., they were extrinsically motivated. This could have been because the check-in function may not have been of any intrinsic value to the user. Based on the results, further achievements could simply be added to encourage participants to keep checking in. However, whether this continues to encourage them or not needs to be further explored. It is likely that adding more achievements for the same task will eventually

bore students. Therefore, exploring how to make the activity more intrinsically motivating may be worthwhile.

Results suggest that participants found different game elements more appealing than others. In this way, it may be worthwhile considering how to design for different player demographics in future gamification designs. In this way, a gamification design that caters to different players means that more users might enjoy the design for longer. These results align to research undertaken after this study (Ferro, Walz, & Greuter, 2013), which also proposes that additional factors such as personality should be considered in the design of gamified systems.

Finally, the restriction on users to add friends by bumping phones meant that this feature was not very useful. This choice had been made to limit the potential for users to cheat and complete the social achievements by manually adding a fake friend. This balance between usability and enjoyment needs to be considered further during the design process in order to maximise both the function of the tool and the fun of the game.

In particular, the goals of the game could have been better aligned to the behaviour change goals. Additionally, adding gamification meant the experience became more game-like. Player preferences could have been taken into account to make a more suitable design. Also, the gamification design could have been more challenging. Additionally some participants were motivated to test the boundaries of the gamification rules, which lead to cheating. These aspects should be considered more fully in the process of gamification design in order to lead to a more effective experience. This section of the chapter explores these aspects in further depth.

5.3.5 STUDY LIMITATIONS

There were a number of limitations with this field study. Most notably, the sample size and lack of correction for experiment-wise error rate means that future research should seek to replicate these findings with a larger sample and more conservative statistical analysis. Additionally,

the novelty of a smartphone application may have influenced the results, when compared to the paper event list currently provided to students. Future research should aim to explore these questions over a longer timeframe. Application usage information was only captured for the 13 participants who used the non-gamified version. This may have affected usage data comparisons and a different method could be used to capture usage information more effectively in the future. Finally, more established and validated scales could be used to confirm the findings. Nonetheless, this study provides a useful exploration into the use of the initial gamification design framework, and the effect of achievements in non-game contexts.

5.4 CHAPTER SUMMARY

This chapter presented and discussed the results of a field study that evaluated the orientation gamification design. A total of 46 new students were recruited for the field study to try one of two orientation applications for a day, either a gamified or a non-gamified version. The results from the field study suggest that adding an achievement system to the orientation application did not affect the user experience or perceived motivation. Results did suggest though that the gamified version encouraged participants to check in to more events and add more friends than those who used the non-gamified version. The gamification design was also well received, indicating the initial framework was useful. However, the results of the field study also suggest that some improvements could be made to the framework to aid in the design of a more effective gamification experience. These improvements are outlined in the next chapter.

6. IMPROVING THE DESIGN FRAMEWORK

This chapter proposes an update to the gamification design framework that is drawn from results of the previous study and an investigation into games and motivation. Principal changes to the framework include a move from extrinsic to intrinsic motivation and a focus on designing the gamification experience like a game, where the user is viewed as a player. In addition, six potential gamification problems are discussed proposed and a tool is proposed to help address these problems.

6.1 UPDATING THE FRAMEWORK

The gamification design framework proposed in Chapter 2 was established as a way to operationalise the gamification design process used in previous research and industry examples. This framework was used to design a gamification experience for university orientation that used achievements to encourage orientation participation. The results of the field study suggest that this gamification design was somewhat effective. However, there were also a number of areas that could have been considered further in the design process.

One key element missing from the gamification design framework was consideration for the design of the 'game' being experienced by users. Although this seems to be obvious, the results from the previous study indicate that rather than just picking an appropriate game element such as achievements and adding it to a system, it may be more useful to design the gamification experience like a game. In particular, taking note of the target player and what they like in terms of gameplay experiences, and then designing a suitable experience that is crafted for them. Also instead of simply running a usability study, it may be more useful to also playtest the added game elements – looking at how enjoyable the player finds them and fixing any gameplay issues.

Therefore, further work is needed to try to determine how to update the gamification design framework to design a more effective gamification experience. To do this a valid starting point would be to look at the

origins of gamification – games, and in particular try to understand what makes games so motivating to play, and how this can then be applied to a gamification context. This requires further investigation into the effect of game elements on motivation, focusing on how different gamification designs could promote different types of motivation. Additionally, if a gamified system can be considered a game, and the users of the system considered players, then an effective gamification design should consider different player demographics, how to promote enjoyment and challenge in the design, and how playtesting can be used to create a more enjoyable player experience. Finally, although game-like, a gamification experience is nonetheless used for a serious purpose. Therefore, the balance between the function of the tool and fun of the game needs to be considered, along with the potential problems that could arise out of the combination of playful elements with a serious task. These aspects are explored further in this section of the chapter.

6.1.1 MOVING BEYOND REWARD-BASED DESIGNS

According to the Self-Determination Theory (SDT), proposed by Ryan & Deci (2000), activities are identified as being intrinsically motivating when they are pursued for their own sake or for their inherent satisfaction. It has been hypothesised that games are primarily undertaken for intrinsically motivating reasons (Ryan & Deci, 2000). On the other hand, activities are seen as being extrinsically motivating when they are performed in order to attain a separable outcome (Ryan & Deci, 2000), or pursued for an external reason to access a desired end state or to avoid an aversive one (Przybylski et al., 2010). By adding game elements to a non-game context that act as rewards for completing tasks, such as the achievements, this can be seen as promoting extrinsic motivation.

Previous research has demonstrated that, compared to those who are externally controlled, people whose motivation is authentic will typically have an enhanced performance, persistence and creativity, heightened vitality, self-esteem and general well-being (Ryan & Deci, 2000). However, the use of expected tangible rewards may instead have

a detrimental effect by undermining intrinsic motivation (Deci, Koestner, & Ryan, 1999; Lepper & Greene, 1978)

A second sub-theory within SDT is proposed (Deci & Ryan, 1985) called the Organismic Integration Theory (OIT). OIT details different motivational types, notably four different forms of extrinsic motivation, ranging from being less self-determined to more self-determined, that is, they are integrated within the self or are externally regulated. These four regulatory styles of extrinsic motivation include external regulation, introjected regulation, identified regulation and integrated regulation. Externally regulated behaviours are the least autonomous, performed to satisfy a separable outcome, such as to attain a reward or to avoid punishment. However, this promotes experiences of being controlled or alienated (Ryan & Deci, 2000). Using reward-based game elements on their own, such as achievements, to motivate users can be seen as promoting this type of external regulation. Introjected regulation on the other hand is a second type of extrinsic motivation often performed to avoid guilt or attain ego enhancements. Using leaderboards in combination with other reward-based game elements aims to promote competition between users. Using these competition-based elements may result in introjected regulation where people are competing for ego enhancements.

The other two regulatory styles of extrinsic motivation proposed, identified regulation and integrated regulation, are more self-determined than the first two. Integrated regulation in particular shares qualities with intrinsic motivation, but is still considered extrinsic as actions are done to attain a separate outcome (Ryan & Deci, 2000). According to Ryan & Deci (2000) the advantages of greater internalisation in terms of motivation include more behavioural effectiveness and enhanced subjective wellbeing, amongst others.

Gamification implementations in both industry and research have often focused on using reward- and competition-based game elements such as achievements and leaderboards. Nicholson (2012a) proposed that issues exist with using primarily reward-based elements to motivate in gamification design, as they focus on supporting extrinsic motivation.

Landers and Callan (2011) also discussed gamification as being grounded in motivational psychology. These researchers also noted that current gamification implementations might be relying too heavily on reward-based game elements. However, these reward-based elements can be relatively easy and cheap to implement on top of existing systems, such as websites or mobile applications. Using these elements alone may be appropriate where a user is amotivated to undertake an activity. However, using these elements may not promote integrated regulation of the activity, or they could even have a detrimental effect on intrinsic motivation (Lepper & Greene, 1978, Deci, Koestner, & Ryan, 1999).

Alternatively, instead of simply using reward-based game elements like achievements to promote desired behaviours, it may be possible to design a more game-like experience around the desired behaviours in order to promote intrinsic motivation, or at least promote greater integration of extrinsic motivation. It has been hypothesised that games are primarily enjoyable and motivating to the extent that players experience autonomy, competence, and relatedness while playing (Ryan & Deci, 2000). SDT proposes that satisfying these three innate needs allows for optimal function and growth (Edward L. Deci & Ryan, 1985).

Autonomy refers to the choices people make and why they make them. When people choose to take on an activity for interest or personal value rather than for rewards or because they are made to do it, then perceived autonomy is high.

Competence refers to the ability to optimally challenge people. Competence also relates to theory of Flow (Csikszentmihalyi, 1990), which that describes a mental state of operation where a person is fully and completely immersed in an activity. People in a flow state report feelings of energised focus, full involvement, losing track of time and a high level of enjoyment and fulfillment. The concept of flow has been found to occur in a wide range of fields such as education, music, and sports. It has also been adopted and studied for its application to both computer systems (e.g., Webster, Trevino, & Ryan, 1993; Novak & Hoffman, 1997;

Finneran & Zhang, 2003) and video games (e.g., Chen, 2008; Cowley, 2008; Sweetser & Wyeth, 2005;). To promote flow a challenge that is appropriate for the skill level of a person needs to be provided; if the challenge is too hard then the person may feel anxious and overwhelmed, and if the challenge is too easy, it can bore the person.

Relatedness refers to a person's connection to and support from others. The need to interact, be connected to and experience caring for others can be a powerful motivator.

If these three elements are considered when designing game elements for non-game contexts, rather than using reward-based game elements only, then the player might be more engaged with the non-game context. Therefore, gamification could potentially be used to foster behaviour change in two ways: by providing an alternative, external goal to complete tasks – such as receiving points or badges; or potentially by supporting competence, autonomy and relatedness. Both of these techniques are discussed in detail in the next sections.

GAMIFICATION AND EXTRINSIC MOTIVATION

Using reward- or competition-based game elements, to create alternative goals in non-game contexts, can promote extrinsic motivation. Extrinsic motivation explains the undertaking of an activity for a separable outcome, for example engaging in an activity to receive points or a badge. For the last few years the concept of gamification has often been tied to these extrinsic reward- and competition-based game elements. Badges, points and social leaderboards have been applied to many different computer applications and social media contexts (Antin & Churchill, 2011). These game design elements can be relatively cheap and easy to implement. A number of platforms are available (e.g., Bunchball) that allow web administrators to integrate levels, points, achievements and tangible rewards into websites to reward particular user interactions such as commenting, registering, social sharing and making purchases.

However, using these competition- and reward-based game elements on their own have been criticised for not representing the intrinsically

motivating aspects of games (Robertson, 2010; Bogost, 2011). Research has indicated that reward elements such as these can be motivating in the short-term (e.g., De Oliveria, 2010). However, using these elements may also have a negative effect on any users already intrinsically motivated to use the system, as previous research (Deci & Ryan, 2000) has indicated that intrinsic motivation may be reduced through the use of extrinsic motivators.

GAMIFICATION AND INTRINSIC MOTIVATION

As mentioned earlier, the act of playing a game is generally considered an enjoyable and intrinsically satisfying activity on its own. If the addition of game elements to a non-game context has the ability to create a game-like experience, then designing this experience to promote intrinsic motivation may be key to creating a more effective gamification design. Rather than simply adding game elements as rewards for desired behaviours, as was the case in the orientation study, the desired behaviours could instead be used as a basis for gameplay, acting as input for a more fully realised game. In this way game design methods may be a useful addition to the framework. This may include understanding the target players, designing interesting gameplay and utilising playtesting.

Additionally, designing to support flow may also promote a more intrinsically motivating game experience (Sweetser & Wyeth, 2005). Through a number of empirical studies, Czikszentmihalyi (2000) identified and outlined eight major components common to a person in a flow state that include:

1. Confronting tasks we have a chance of completing;
2. Being able to concentrate on what we are doing;
3. Having a task with clear goals;
4. Having a task which provides immediate feedback;
5. Acting with deep, but effortless involvement, that removes us from the awareness and the worries and frustrations of everyday life;
6. Exercising a sense of control over our actions;

7. Having concern for the self disappear, yet, paradoxically having the sense of self emerge stronger after the flow experience is over;
8. Having the sense of duration of time altered.

In studies around computer-mediated environments, three stages of flow have been identified as a framework to aid in designing engaging systems (Webster, Trevino, and Ryan, 1993; Novak and Hoffman, 1997; Finneran & Zhang, 2003). These stages of flow include:

- antecedents to flow: precursors and requirements for experiencing flow (e.g., clear goals, skill, challenge, interactivity)
- the flow experience: experiencing flow (e.g., concentration, loss of self-consciousness, time distortion)
- the consequences of flow: outcomes and effects of experiencing flow (e.g., positive effect, exploratory behaviour, control, autotelic experience).

Designers considering these three stages when designing a system can better understand how elements of flow can potentially be supported. Finneran and Zhang (2003) proposed the Person-Artifact-Task (PAT) model to discuss how the interrelationship of a person, a task and an artifact may affect flow. They propose that both the flow experience and flow consequences rely on antecedents of flow, where along with the trait and state of the user, design choices made can influence flow. In this way the designer has the potential to emphasise various components of the flow antecedents in order to create a more positive user experience. Webster, Trevino, and Ryan (1993) propose that systems designed to promote user control, focus and enjoyment may result in more positive work outcomes. The PAT model has also been adapted to create a new model to inform computer game play, the User-System-Experience (USE) model (Cowley, Charles, Black, & Hickey, 2006). The GameFlow model has also been proposed (Sweetser & Wyeth 2005) for evaluating player enjoyment in games. This model maps elements of a flow state to a set of gameplay criteria but could also be used for designing video games and gamification. Note, points and rewards can still be used to provide feedback for the gameplay rather than just as external rewards. By designing a gamification experience like a game,

where enjoyment and player demographics are considered, may lead to a more intrinsically motivating experience.

6.1.2 DESIGNING LIKE A GAME

Gamification is the use of video game design elements to engage users in non-game tasks. It is theorised that adding game elements to a non-game context can result in a game experience where the desired behaviours act as game input. Results from the previous study support this theory that a game is being created – players found the activity enjoyable and game-related activities took place that normally would not when using the application (e.g., cheating). Results also suggest that designing challenging and fun game activities is important. Therefore, rather than adding reward-based game elements, designing the gamification experience more like a game may instead be a better approach to gamification design – where the user is considered a player, game design techniques are adopted, and playability testing is undertaken.

THE USER AS A PLAYER

Results of the previous study suggested that different participants liked different game elements used in the design. Therefore, considering the user as a player and identifying what they like in a game may be a good starting point as people who play different types of games can have different motivations for playing (e.g., Bartle, 1998; Yee, 2006). Previous research has found that adding game elements to non-game contexts affected gender and age differently. For example, Malone (1981) found that there was a significant gender difference when it came to what boys and girls liked about game elements added to a mathematics application. Another application called *Chick Clique* aimed to encourage girls to undertake more physical exercise by rewarding them for the number of steps walked each day (Toscos et al., 2006). Results found that the design influenced older girls more than it did younger girls. In the orientation study outlined in the previous chapter, the results suggested that different player preferences occurred.

GAME DESIGN

Using game design techniques and processes might prove useful during the gamification design process. For example, the literature review highlighted previous research that has used game design methods and processes to inform gamification design. Some designers studied games to influence the design of a game-like system (Malone, 1981; Montola et al., 2009), others referred to using books on game design (Guin et al., 2012) or chose game elements that they felt most appropriate for a tutorial system (Li et al., 2012), based on previous game design research (Hunicke et al., 2004; Malone, 1981, 1982; Sweetser & Wyeth, 2005). Similar techniques may be worthwhile adopting as part of the design framework.

Another useful game design process that could be adopted is the development of a game design document for the gamification. A game design document provides an overview of the game concept, scope, and feasibility. It can also provide technical details of the project, as well as a range of other details such as story, aesthetics, level design and controls. There are a number of free templates available online (e.g., Taylor, 2000) that could be used. However, these templates may need to be adjusted, as not all of the template may be applicable to the gamification design (e.g., level design may not apply to the design being created and can be ignored).

PLAYTESTING

In the previous study, some participants admitted to cheating. The usability study alone did not provide much feedback on issues such as cheating; nor did it help identify game elements and interactions that were not overly enjoyed by users (e.g., number entry). Therefore, running playtesting sessions would be a worthwhile undertaking for finding issues with the player experience. Similar to playtesting games, playtesting gamification would involve recruiting players of the target demographic to use the gamification design and provide feedback on their experience.

6.1.3 BALANCING THE FUN AND FUNCTION

Central to the design of software applications are usability goals, with core aspects such as efficiency, learnability, good utility and ease of use. Lazzaro & Keeker (2004) emphasise that the goal of productivity software is to make a task easier to complete and should reduce workload. Video games on the other hand are meant to increase workload, entertain players and be challenging (Lazzaro & Keeker, 2004). Video games should also taking into account aspects such as challenge, fun and playability (Sweetser & Wyeth, 2005). When adding game design elements to motivate users in non-game contexts, the application has the potential to be used like a tool *and* a game (e.g., in *foursquare* a user could use the application to share their location with friends, or could also check-in to as many places as possible to get a high-score). When this happens there is a potential for conflict to occur between the goals of the tool and the goals of the game. From the results of the orientation study, and from research and industry examples, six potential gamification design problems have been identified that could arise when attempting to balance fun and function in gamification designs.

PROBLEM 1: GAMES ARE VOLUNTARY

Games are defined as having the quality of being "an exercise of voluntary control systems" (Avedon & Sutton-Smith, 1971) where they "are entered wilfully" (Schell, 2008) by players. There may be issues with automatically forcing a user to take part in a game-like experience when using a non-game system. Take *foursquare* as an example – it is a system that allows users to share their location within their social network of added friends. Every time a person checks in to a location using foursquare they are automatically awarded points depending on the context of the check-in. These points along with badges, a leaderboard and mayorships, were a mandatory part of the service. Making them mandatory, rather than voluntary, may have a negative impact on the experience as it automatically subscribes users to the game. Some users may feel forced to play or the game design elements may not appeal to all users. In a similar way it was found that the addition of achieve-

ments to the photo sharing service *Nokia Image Space* was confusing and disliked by some users (Montola et al., 2009).

PROBLEM 2: PLAYER ENJOYMENT CAN WANE OVER TIME

For computer games, player enjoyment "is the single most important goal" (Sweetser & Wyeth, 2005). Game elements added to a non-game context should therefore aim to create a playful experience – one that is fun, challenging, and enjoyable, or otherwise the game design elements may detract from the experience. If the user does not enjoy gamification experience created then they may become bored with it or may stop using the entire system altogether, in particular if the game elements were the reason they were attracted to the system in the first place. More importantly though, most games will not engage players forever; once players work out the challenge or puzzle of a game, then they can become bored with it (Koster, 2010). Farzan et al. (2008) found that adding points, levels, and leaderboards to an enterprise social network led to an immediate increase in contributions but then motivation to contribute declined shortly afterwards. Therefore, unless new and interesting challenges are continually being added to a gamified experience then enjoyment may wane.

PROBLEM 3: GOAL MISALIGNMENT OF THE TOOL AND GAME

There is a need to make sure the gamification goals align with and support the goals of the tool. Take for example Internet forums, which are online tools that aim to facilitate discussion and conversations around a general topic. The choice to integrate game elements to encourage users to post may seem appropriate; for example, the achievement system that was added to the AusGamers forum (AusGamers, 2010). One achievement encouraged users to write 100 forum posts. However, this achievement focused on the quantity of posts and not the quality, which led to users creating forum posts just to complete the achievement. This could impact on the original goal of the forum, which is to facilitate discussion.

PROBLEM 4: DISTRACTIONS, EXTENDED TASK COMPLETION TIME, AND OVER-INVOLVEMENT

A negative consequence of adding playful elements to a tool is that task completion time could take longer (Webster, Trevino, & Ryan, 1993). Users may become sidetracked by game elements, working out how to complete them instead of performing another task with the tool. Task completion could also be affected when game elements distract an already intrinsically motivated user, or simply interrupt the flow of use. For example, the *GiantBomb* website previously awarded achievements to users for browsing specific pages on their website. When an achievement was awarded, a popup appeared in the bottom right-hand corner of the screen. This provided great immediate feedback for a user who was traversing the site to explicitly unlock achievements; however, the same popup could distract a user from the task at hand, especially if they were not expecting to receive an achievement.

These interactions could also be seen as automatically enrolling a user to a game, even if they did not want to play, which may have a controlling effect and potentially affect their motivation to use the system. Another possible negative outcome from the addition of playful elements could be over-involvement (Webster et al., 1993), where the enjoyment of one task might make people neglect other tasks, including those outside of the system.

PROBLEM 5: CHEATING

If game elements encourage game-like behaviour then cheating is likely to become a problem as "the experience of playing a game is always influenced by the possibility of 'illegal' manipulation" (Kuecklich, 2004). The earlier example of the AusGamers forum thread being opened just to complete the achievement could be seen as a form of cheating by users. This is a reoccurring issue being found in research studies. One study (Singer & Schneider, 2012), which looked at adding a leaderboard to a software system for committing changes to software when it was being developed, found that one user admitted that felt they tried to game the system by changing their behaviour. Another

study where game elements were used to encourage green transportation habits found that participants considered cheating (Froehlich et al., 2009). Cheating may affect not only a user's experience, but also the experience of other players (Kuecklich, 2004). For example, if a user cheats in *foursquare* by checking in to a place they have not visited, this could affect the experience of their friends, who may think they are currently at that particular location. Cheating may occur because the system allows it due to flaws in the ability to determine user actions accurately (e.g., location using GPS can still be inaccurate).

PROBLEM 6: ETHICAL ISSUES AND SAFETY

The pervasive qualities of gamification raise certain ethical considerations, in particular, if the game design elements are being designed around real actions that involve potential risks, such as exercising (Toscos et al., 2006), taking medication (de Oliveira et al., 2010), or drinking water (Chiu et al., 2009). Designers need to consider if any added game elements may put users at risk. When motivated or distracted by challenge, competition or the reward of a game, some people may forget the risks involved with the activity. A lawsuit was filed, but later dismissed, after the death of a cyclist who used the application *Strava* (Dinkelspiel, 2012). This application allowed users to record their exercise times, compare them with others and compete for the best time. Toscos et al. (2006) found that participants thought that competitive elements in a mobile application that encouraged exercise could lead to excessive exercise as well.

6.2 THE UPDATED DESIGN FRAMEWORK

An updated version of the gamification design framework was proposed to aid in the design of more effective gamification. The primary objective of this design framework was still the same – to aid in the design of an effective gamification experience. However, the updated framework is now based on the following three phases:

1. **Justify** the motivation and requirements for gamification
2. **Design** the gamification experience
3. **Evaluate** the gamification experience

Each phase contains a number of steps. The phases and steps combined make the updated gamification design framework, as depicted in Figure 6.3. Each updated step is outlined in detail in the next section.

Figure 6.1 – The Updated Gamification Design Framework

6.2.1 PHASE 1: JUSTIFY THE MOTIVATION FOR GAMIFICATION

The three steps involved with justifying the motivation for gamification are identifying the problem and goals, determining if gamification is worth using, and translating the goals into specific behaviours.

STEP 1: IDENTIFY PROBLEMS AND GOALS

The first step of the framework is that, given a particular context, there should be a problem that needs to be addressed. The problem should be clear (e.g., teenagers are not getting enough exercise; users are not completing their profile on a website) and may be identified using a variety of different methods, such as reviewing previous literature, or undertaking questionnaires, interviews, focus groups, workshops, observations, or studying documentation. There may be more than one problem that needs to be addressed. Once the problem has been established, a number of goals can then be identified that address the problem (e.g., encourage regular exercise, or encourage profile completion). These goals can be kept quite general, as they will be turned into more specific, measurable behaviours later in this phase. These goals will become the foundation of the gamification to be designed.

STEP 2. DETERMINE IF GAMIFICATION IS APPROPRIATE

As discussed earlier in the chapter there is a possibility that adding game elements to particular activities could result in negative consequences. Therefore, it is worthwhile at this point in the process before designing begins to ask if there could there be negative consequences when framing the activity as game-like.

If the problem is inherently serious in nature (e.g., the system uses sensitive or personal data such as health records), or requires a serious attitude (e.g., the system helps someone with credit card fraud) then a playful gamification solution may not be appropriate in this particular context.

STEP 3. DETERMINE DESIRED BEHAVIOURS

If a gamified solution is identified as worth pursuing, then design can continue and the goals identified in step one can be turned into appropriate measurable behaviours. The goals initially defined are likely to be quite general (e.g., undertake regular exercise) and they will need to be turned into specific, measurable behaviours that meet these goals and also address the problem (e.g., undertake 30 minutes of high-

intensity exercise every day). The aim will be to measure these identified behaviours by using the technology available, and then encourage these behaviours through the gamification design.

6.2.2 PHASE 2: DESIGN THE GAMIFICATION EXPERIENCE

The three steps involved when designing the gamification experience include working out how to measure and enforce the metrics, understanding the player, and designing the gamification.

STEP 4: IDENTIFY APPROPRIATE SENSING

Once the desired behaviours have been identified, as in to the previous framework, the next step is to find the most automatic and accurate way to measure them. As discussed for the first version of the framework, there are three primary ways in which behaviours can be measured. The first is to automatically measure them using technological sensors. The second way is to get someone else to measure the behaviours, for example using crowdsourcing. Alternatively, behaviours can be self-measured (i.e., by the user themselves). The advantage of automatically capturing interactions using sensors is that players do not have the burden of needing to enforce the gamification rules themselves. Therefore, using automatic sensing techniques should be considered first, as they provide a way to sense behaviours without human intervention. If activities cannot be successfully measured this way, then crowdsourcing or self-measuring options can be explored.

A number of design suggestions can be drawn from the findings of the previous study. Results suggest that it is important to find the right sensing technique to enforce the added game elements, as some sensors may not be very reliable and could lead to cheating. By determining multiple ways to sense certain activities, decisions can be made as to which is the most appropriate choice of input for the game elements. To aid in the decision, it could be worthwhile considering if the sensing technique chosen is easy to use. An automatic sensing technique is likely to be easier to use, as it is automatic. However, the sensing technique also needs to be accurate. Although location can be sensed automatical-

ly using a GPS sensor, it may not be accurate when used indoors. Therefore, a different sensing technique may be needed that is less easy to use, but is at least more accurate. It is also important to consider if the input method might be fun to use, for example, students enjoyed scanning QR codes to determine location, even though this method was not as easy as using the GPS sensor. Finally, cheating needs to be considered, and designers should evaluate the potential for users to cheat using the chosen sensing techniques. Employing multiple sensors (e.g., scanning a QR code *and* capturing the location of a user using a GPS sensor) could help to maximise accuracy and minimise cheating. To summarise, a sensing technique for a gamification design should be accurate, easy to use, enjoyable, and not susceptible to cheating.

STEP 5: UNDERSTAND THE PLAYER

Considering the user as a player can help to understand what they may like in games. Age and gender are significant demographic variables to consider, as these will help determine play patterns and interests in terms of games (Schell, 2008). For example, kids aged 7 to 9 years old typically play differently to teenagers aged 13 to 18. Gender differences may also occur: Schell (2008) suggests that if the audience is primarily male, then the game designer may consider using more elements of mastery, competition, destruction, spatial puzzles, and trial and error as these are things that males typically like to see in games. However, females like to see elements of emotion, real world, nurturing, dialog and verbal puzzles, and learning by example, like to be seen in games. Although generalisations, these ideas are nonetheless useful when making games for large audiences (Schell, 2008). Different motivational factors and models for gamers have also been proposed (Bateman & Boon, 2005; Levy, 2006), which may also be worthwhile considering during the gamification design.

Finally, if the target user group is large then it may be difficult to design a gamification experience that appeals to all users. Instead it may be easier to focus on appealing to a smaller subgroup of users who share similar player demographics.

STEP 6: DESIGN THE GAME

Once the sensing techniques and target player have been identified, the gamification experience itself can be designed as a game. The focus of this step is to design an effective gamification experience around the desired behaviours. As discussed in the literature review, reward- and competition-based game elements such as achievements, points, and leaderboards have been popular elements explored in a number of previous gamification studies (e.g., Montola, 2009; de Oliveira, 2010). However, supporting autonomy, competence and relatedness is an important focus of the design in order to attempt to create a more intrinsically motivating experience, or one that at least promotes integration. The literature also discussed how games use more than just reward-based elements - they support intrinsic motivation by promoting fun through a combination of play, rules, goals, challenges, feedback and rewards.

Designers can begin by identifying areas of the activity where flow antecedents are not being fully supported. For example, a clear goal may not exist, or feedback might be lacking. Designers can then aim to introduce elements that support these antecedents of flow, based on the use of the PAT model described earlier (Finneran & Zhang, 2003). For example, the user profile section of the LinkedIn social network encourages users to fill out their profile by using a number of game-like elements to provide feedback, clear goals, and a sense of control to the user. The progress bar provides feedback on whether the user's profile is complete. A list of profile completion tips not only provides clear goals, but also allows the user to make a choice as to what they could complete next, which supports autonomy. The percentage weighting next to each tip provides users with feedback as to the importance of each task, allowing a more informed decision to be made based on which task may be more difficult or is worth more. A gamification experience may also be designed which more closely resembles a fully-fledged game, such as *Chore Wars*, which creates a dungeons and dragons style game around completing household tasks.

For this kind of experience the target behaviours can be used as core game mechanics. Rules can then be created around these behaviours, and game elements can be chosen to support the game experience and player demographics. This is a similar approach taken for bottom-up design approaches proposed for video game design (Lopes & Kuhnen, 2007). Hiring a game designer to help with the design of the gamification could be useful as well. Additionally, a game design document could also be created which outlines the story, mechanics, goals, rules, challenges, actions, aesthetics, and feedback. It is also worthwhile documenting how the design can support flow by evaluating the design using the GameFlow model discussed earlier (Sweetser & Wyeth, 2005).

6.2.3 EVALUATE THE GAMIFICATION EXPERIENCE

Finally, three steps are proposed for evaluating the gamification experience designed that include identifying any gamification-related problems, evaluating the design as both a tool and game, and balancing these two parts.

STEP 7: ADDRESS ANY GAMIFICATION PROBLEMS

Although similarities exist between gamification and video game experiences, these can also differ quite substantially. Adding game elements to non-game contexts can lead to a number of unique design considerations and challenges. These unique problems, discussed earlier in this chapter, are important to address in the gamification design process before it is deployed. To help aid designers to identif these problems in their gamification design, six heuristics (or general principles) have been proposed as a starting point. Designers can use these proposed heuristics to perform a heuristic evaluation – an informal method where specialists judge whether the system follows the proposed principles (Nielsen, 1994).

HEURISTIC 1: CONSIDER MAKING GAMIFICATION VOLUNTARY

Tension or confusion may arise if users are automatically subscribed to take part in a gamified experience. Some users may feel forced to play, or the game design elements included may not appeal to all users. To address this issue any added game elements could be made an optional

extra that can be turned on or off. For example, the *Ribbon Hero* training tool for Word is an additional download that is not forced on the user.

HEURISTIC 2: TAILOR THE EXPERIENCE TO THE PLAYER

Any added game elements should create an experience that is fun, challenging, and enjoyable. Otherwise, the game elements may detract from the experience or become boring over time. Identifying and designing for the target player demographic may help to address this issue. Undertaking playtesting as well can help to reveal if the user enjoys the game elements.

HEURISTIC 3: ALIGN THE GOALS OF THE TOOL AND THE GAME

The goals of the gamification experience need to align to the goals of the system. However, it may be difficult to identify goal misalignments, but playtesting may be able to help. If any misaligned goals are found then the gamification can be changed to address them, or certain game elements can be removed to fix the problem.

HEURISTIC 4: MINIMISE INTERRUPTIONS UNLESS WANTED

Task completion could also be affected when game elements distract an already intrinsically motivated user, or simply interrupt the flow of use. A solution to minimising interruptions could be to not interrupt system tasks with game elements unless the user has explicitly indicated that they want to be interrupted. If at all possible it would be useful to try and determine how each user is engaging with the system. If they are not intrinsically engaged with the tool side of it, then game elements could be employed. Otherwise, game elements could be toned down or ignored completely if they are already intrinsically engaged in the system tasks.

HEURISTIC 5: MINIMISE THE POTENTIAL FOR CHEATING

Cheating may often occur due to flaws in the system, such as the inability to determine user actions accurately (e.g., location can still be difficult to accurately measure). To counteract cheating, designers can enlist different measures to enforce the game design elements. Additional sensors could be used or enforcement could also be

crowdsourced. Otherwise, any game elements that lead to cheating issues could simply be removed from the design altogether.

HEURISTIC 6: HIGHLIGHT RISKS AND ADD A DISCLAIMER

Ethical and safety issues should be relatively obvious to identify by designers, but others may only be found by playtesting in safe conditions. It may be important to include a disclaimer and highlight any potential risks to the user. For example, *Zombies, Run!* is a running application that includes an optional Zombie chase mode where players need to run faster in the real world to outrun virtual zombie hordes. This mode requires players to opt-in to use it and also provides a disclaimer that reads: "You are enabling zombie chases AT YOUR OWN RISK. Please run safely - stay aware and give way to moving vehicles at all times". If initial risks might not be obvious in the gamification design then it may be worthwhile to use scenarios and playtesting to reveal any risks that may need to be addressed. It may also be worth explaining to users why a particular action is being encouraged and provide research that supports the action.

STEP 8: EVALUATE AS A TOOL AND A GAME

When developing a system a useful activity in the design process is to evaluate its usability. By looking at the gamification experience as a tool, and the person interacting with it as a user, then aspects such as utility, usability, and user experience can be evaluated. There are a number of ways to study usability; one of the most useful is user testing involving observing representative users performing representative tasks with the design (Nielsen, 2012). Testing five users is suggested to be typically enough as running a number of small tests and revising the design between tests is suggested to be a better use of resources (Nielsen, 2012).

However, if game elements are being added to a system then it may also be worthwhile evaluating it like a game. Playtesting with players and expert reviews are common evaluation methods for games (Korhonen, 2010) and could be adopted to evaluate gamification experiences as well. Playtesting is similar to user testing where a number of representative players are recruited and observed undertaking repre-

sentative tasks in the game (Korhonen, 2010). However, in addition to usability aspects, the fun and enjoyment a player is having is often also explored. User testing for both usability and fun can be run simultaneously.

It is also important to investigate if the gamification experience is having the desired effect in terms of the original problem and the goals identified in step one. Field experiments that compare a gamified application to a non-gamified application have been a popular way to measure the effect of gamification in previous research and it may be worthwhile running field testing or a pilot study to evaluate the gamification experience. Usage data may provide insight into how the added gamification experience is having an effect on the problem. It may also be useful to compare the effect of the gamification on the user experience to a non-gamified application, similar to the study in the previous chapter. Currently there is little in the way of validated measures for investigating the effect of gamification on a user's experience. However, measures could be adopted from other related contexts. For example, Koufaris (2002) looked at how flow theory and the technology acceptance model applied to online consumer behaviour. They developed validated metrics for researchers and practitioners based on similar previous research used to measure concentration, user enjoyment, perceived control, user challenge, perceived usefulness, and perceived ease of use (Ghani, Supnick, & Rooney, 1991; Novak & Hoffman, 1998; Venkatesh & Davis, 1996). These measures can be adopted and used for evaluating similar measures in a gamified system used in a pilot or field study.

STEP 9: BALANCE THE TOOL AND THE GAME

Finally, once the design has been evaluated, then changes can be made to it in order to address any problems with usability or playability. This involves making changes based on the findings from the evaluation. Once changes are made steps seven and eight can be repeated to make sure the changes made have not created any new gamification issues and are having the desired effect. Known as iterative design, this is one of the best ways to increase the quality of user experience (Nielsen,

2012). With iterative design, sketched wireframes may be created first with multiple iterations, and then interactive wireframes may be made (Nielsen, 2011). A working prototype can be made before moving on to the final product. Once the gamification design is deemed acceptable and effective through iterations of evaluation and adjustment, then the system can then be released.

6.2.4 USING THE GAMIFICATION DESIGN FRAMEWORK

The gamification design framework may be used to help create new gamification experiences or even be used to help evaluate existing gamification experiences. The aim of the framework is to provide a more structured process for effective gamification design: one that takes into account potential gamification problems that may not be present when using established HCI design methods and processes. Note that the framework is not meant to replace existing methods and processes. In fact it may work better when used alongside a user-centered and iterative design approach.

6.3 CHAPTER SUMMARY

This chapter proposed an updated gamification design framework, with changes made to it based results of the previous study and relevant literature. The primary updates to the framework included a more focused approach on supporting intrinsic motivation when designing a gamification experience, as well as designing and evaluating the experience like a game. Six gamification heuristics were also proposed and added to the framework to be used to identify any potential problems with the gamification design.

7. DESIGNING A GAMIFICATION EXPERIENCE FOR LEARNER DRIVERS

This chapter presents a detailed overview of a gamified experience designed using the updated gamification design framework. The gamification experience is integrated into a learner logbook smartphone application developed to help support learner drivers to record their supervised driving practice. The added gamification aims to encourage learner drivers to undertake more diverse and regular practice.

7.1 THEORY BUILDING AND TESTING

As discussed in chapter four, a common theory regarding gamification was that the use of competitive- and reward-based game elements would often result in behaviour change and increased enjoyment. However, the literature reviewed in chapter two revealed mixed results when it came to determining the effect of this type of gamification on behaviour change. In addition to this, the literature reviewed also revealed that some gamification implementations occasionally resulted in negative user experiences. The results of the orientation field study supported these findings – although the addition of achievements encouraged some additional function use, there was no impact on user experience, and a number of problems arose with the design (e.g., cheating).

It was theorised in the previous chapter that when game elements are added to a non-game application, the application has the potential to be used as both a tool and a game by the user, sometimes simultaneously. Therefore, designing a gamification experience like a game, and thinking of the user as a player, may result in a more effective gamification design. However, there may be unique problems that arise when trying to balance the functionality of the tool with the fun of the gamification experience. This chapter explores the effect of designing gamification more like a game by using the updated gamification design framework proposed in chapter six to design a gamified logbook application.

7.2 JUSTIFYING A GAMIFIED APPLICATION FOR LEARNER DRIVERS

Younger drivers are at greater risk of death and injury from road crashes than older and more experienced drivers. Road crashes are the leading cause of death for persons aged 16 to 25 years (e.g., OECD & ECMT, 2006; World Health Organization, 2014) and the second most common cause of disability for male and female adolescents alike (World Health Organization, 2014). In Australia in 2013, young drivers aged 17-25 years made up 21.3% of the fatally-injured drivers (BITRE, 2013). In the Australian state of Queensland in 2013, 35.0% of hospitalised casualties were from crashes involving drivers aged 17 to 24 years. It is worth noting that young drivers aged 17 to 24 years comprise only 12.9% of Queensland's licensed driving population (DTMR, 2013).

7.2.1 PREVIOUS RESEARCH

There is little evidence that indicates driver education, training, and media campaigns are effective at reducing crash and fatality rates of young drivers (Hedlund, 2007). On the other hand there is growing evidence to show that graduated driver licensing (GDL) programs can be seen as effective (Scott-Parker, Bates, Watson, King, & Hyde, 2011). Governments across Australia are employing a range of strategies aimed at addressing this issue. As of July 2007 all Learners in the state of Queensland, must achieve a minimum of 100 hours of supervised driving experience (including 10 hours of driving at night) before applying for a Provisional (intermediate) license (DTMR, 2014). Similar programs are used in other Australian states, in New Zealand, and also internationally (e.g., in some jurisdictions in the United States).

In Queensland, practice hours are manually recorded in a large paper logbook (16cm x 22.5cm). The information required to be logged for each driving session includes the date, the time at the start and at the end of the session, the driving duration (in minutes), the car's odometer at the start and at the end of the session (in kilometers), the licence number of the supervising driver, the State in which the supervising driver is licensed, the supervisor's signature, the car number plate, and

whether the supervisor is a registered driving instructor. Once the minimum number of hours has been reached, and the logbook has been correctly filled out, it can then be submitted to the Department of Transport and Main Roads (TMR) and audited for accuracy and completeness. The audit is done manually and takes approximately two weeks. If there are no issues with the logbook then the learner driver is permitted to undertake their practical driving assessment.

Using a physical book to track supervised driving practice has a number of usability issues; it takes time to fill out practice sessions, it requires a black or blue pen, and the book needs to be carried with the learner as they move from car to car. If the logbook is lost, replacing it not only incurs a cost; the hours previously recorded also need to be accurately remembered and reliably transferred to the new book.

To address these issues a number of unofficial smartphone logbook applications have been developed as an alternative way to record practice. A smartphone logbook application could easily alleviate the majority of the usability problems listed, and is a more appropriate tool for the technology-oriented youth of today. Also, an application allows the process of logging practice to be improved and streamlined by using sensors available on the device. Practice can also be automatically backed up to an Internet server in case a learner driver's phone becomes broken, lost, or stolen.

Research has indicated that the updated GDL program in Queensland has encouraged significantly more supervised driving practice than before the mandatory logbook was introduced (Scott-Parker et al., 2011). However, the same research indicates that additional learner driver activities could be encouraged, suggesting that learner drivers should aim to:

- Spread the practice over the learning period
- Continue practising beyond the mandated one hundred hours
- Drive in a variety of different circumstances that become progressively more challenging

Undertaking these activities could lead to safer drivers. However, there is little that exists to encourage learner drivers to undertake these additional activities.

Gamification could potentially be used to encourage learners to undertake more diverse practice, especially when introduced into a learner logbook smartphone application. Previous research suggests positive results when using gamification to encourage behaviour change, for example taking medication at prescheduled times (de Oliveira et al., 2010) and drinking healthy amounts of water during the day (Chiu et al., 2009). Little research has investigated the use of gamification to engage learners with logging and undertaking practice. However, the use of game elements and mobile devices has previously been explored as a means to influence driver behaviours in other contexts. McCall & Koenig (2012) presented research on using gaming concepts and incentives to reduce traffic congestion. The Speed Camera Lottery (Volkswagen, 2009) encouraged drivers to slow down by entering drivers who did not speed into a lottery where they could receive cash prizes funded by drivers fined for speeding. Game elements have also been integrated into cars to encourage environmentally friendly driving, such as the Nissan Leaf, which uses game elements to reward users who drive economically (Hickey, 2010). In addition to these, a number of government-funded interventions in Australia have used online games to educate learners about on-road risks and safe driving behaviour, such as Keys 2 Drive (keys2drive, 2012) and Road Trip to your Licence (Queensland Government, 2011). Driving simulators have also been explored for their potential to train learner drivers, principally for their ability to provide a safe environment in which to encounter hazards (Blackman, 2005). The use of game elements in the smartphone logbook application could provide a way to encourage beneficial practice behaviour. This provides a suitable opportunity to use and evaluate the gamification design framework in this context.

In order to justify this line of thinking and context, interviews were undertaken with five experts in the field of learner drivers, three from industry and two from academia.

7.2.2 INTERVIEWS WITH EXPERTS

The requirements for the design were primarily gathered through interviews with five experts who were consulted for their extensive knowledge of learner drivers and on-road driving risks. Five industry and academic experts in the field of novice drivers were recruited via email and interviewed over four interviews (two were interviewed together). Each interview lasted on average forty minutes. The experts were widely recognised as leaders in the area of learner drivers at the time, having either researched learner drivers extensively or contributed to state licensing processes. The aim of the interviews was to identify and understand key issues with learner drivers and discuss in-depth various areas that could be improved upon. Initial thoughts and opportunities for a gamified mobile version of the logbook were also discussed. Interviews were semi-structured, with questions focusing on (a) learners in general and some of the challenges they face, (b) the Queensland licensing program, and (c) the current logbook process and opportunities for a gamified mobile logbook application.

The aim of the interviews was to provide additional data and insight to support or reject initial literature findings. Therefore, to analyse this data, a deductive approach was adopted (Zhang & Wildemuth, 2009). Interviews were prepared for analysis by transcribing the recordings and entering them into NVivo 10 for Windows. After each interview was coded, themes were formed to help support and explain the quantitative findings. The output of this activity can be found in detail in the appendix.

To summarise the results, the interviews supported the literature findings, that young driver safety is indeed a considerable public health issue. The inexperience of young drivers in particular was identified as a prominent contributing factor by all interviewees. Feedback regarding the recent changes to the state licensing program was favourable. However, it was also commented that the 100 hours of mandatory practice currently required is *"a crude measure"* of driving experience as it focuses on quantity, rather than quality. It was suggested that the focus should instead be on the breadth of experience a learner driver under-

takes while learning to drive. Beyond attaining the required 10 hours of nighttime driving, interviewees recommended learners should also experience a wide range of other situations. These include basic traffic negotiation (e.g., merging or changing lanes, turning right across traffic, reversing) and driving in different road environments (e.g., single lane roads, multilane roads, heavy traffic, unsealed roads).

Interviewees responded positively to the idea of a gamified mobile logbook and its potential to address logging and engagement issues. However, they were wary of game elements that encouraged competition or challenged drivers to complete tasks that may be beyond their skill level. This was because the pace at which each driver learns is different, and competition or excessive guidance could potentially encourage dangerous driving habits.

A number of design requirements emerged for the gamified logbook application based on the results of the interviews. These included:

- DR1) Provide all the functionality that the current physical logbook provides
- DR2) Streamline the process of logging practice
- DR3) Focus on the experience of practice undertaken, rather than on the hours attained
- DR4) Encourage learners to spread the practice evenly over the learning period rather than undertaking it all just before the test
- DR5) Encourage learners to practice beyond the mandated one hundred hours
- DR6) Encourage learners to drive in a variety of different circumstances that become progressively more challenging in nature
- DR7) Do not encourage excessive competition between learners or provide challenging tasks beyond their skill level as it could lead to dangerous driving

Also discussed was the requirement for significant design considerations when designing a smartphone application to log driving practice. Laws exist in Queensland that prohibit people from driving with a mobile phone in their hand. There is also a ban on all mobile phone use

(including hands-free) for learner drivers and stage one provisional drivers under the age of 25 years (Department of Transport and Main Roads, 2012). Also, passengers cannot have a mobile phone on loud-speaker or hands-free either when currently with a learner or a stage one provisional driver. Based on these laws, one more design requirement was established:

- DR8) Adhere to laws regarding the use of mobile phones while driving, as there is a ban on all mobile phone use (including any hands-free or loudspeaker functionality) for learner drivers.

7.2.3 REVIEW OF SIMILAR TOOLS AND APPLICATIONS

An analysis of twenty-five logbook tools and applications available at the time was undertaken in order to investigate if the problem had already been addressed. A list of the applications can be found in the appendix. Overall the websites and apps had generally positive ratings and comments. Negative reviews generally occurred because the logged data could not be officially submitted as an official record of the mandatory practice, so learner drivers still had to fill out their physical logbook. As this is unlikely to change unless the government allows it, any application being built will have to make it clear that this logbook cannot be officially submitted. A digital logbook nonetheless has benefits and can be used as a backup for the physical logbook.

The Learn2Go website allows learner drivers to manually enter practice hours digitally and submit the times as official evidence of practice. The website offers an online logbook, instructional videos and information sheets with progress checks that can be printed for use in the car, learner drives (pre-determined routes for learner drivers with various categories and difficulty ratings), and resources and links. However, the website has a number of disadvantages, including not being optimised for mobile devices, requiring an internet connection and not being able to automatically record practice while driving. The iOS and Android applications supported these functions to a certain degree (some better

than others); however, none of these applications explicitly aimed to motivate the learner drivers to undertake more diverse practice.

7.2.4 FINDINGS FROM RESEARCH AND INTERVIEWS

A gamified mobile logbook could:

- Aid in the process of accurately logging and submitting hours
    - Less likely to be forgotten between cars and lost; if it is lost, a backup system could be included to make it easier to continue recording hours
    - Could speed up processing time, both submission and checking processes
    - Sensors could be used to automate some of the input learners must provide each trip (e.g., time, distance, suburb etc.)
    - Sensors could be used to provide more enforcement, potentially measuring time more accurately and verifying other information
- Provide detailed feedback to the learner and supervisor
    - Sensors could record practice diversity and provide greater feedback on driving experience gained beyond just the time practised. This could allow for reflection on practice undertaken and allow for planning for future practice sessions.
- Create structured and personalised guidance for learners and supervisors
    - The app could encourage more diverse experience being undertaken
    - Based on the feedback, more structured and personalised guidance could be provided or the app could be used to help plan this
    - Could provide feedback to the parents (e.g., sms or email feedback) or even present a more engaging interface for supervisors, with a guide and recommendations
    - Social aspects could be included - example and shared driving route with difficulty ratings etc.

- Could engage learners and supervisors with the practice
    - Could encourage parents to become more involved and willing to participate
    - Could provide and promote links to other sources of information (TMR website, free2go, road trip etc.)
    - Encourage practice beyond the 100 hours
    - Keep the entire experience engaging over the minimum period of 12 months
- Could be used or deployed nationally and internationally

7.3 LOGBOOK APPLICATION OVERVIEW

A logbook smartphone application was first developed without gamification. The application could record driving practice, display previous practice sessions, and provide useful links and information for learner drivers and their supervisors. The application was developed for the Apple iOS platform, targeting iPhone, iPod Touch and iPad devices. Research by International Data Corporation (Hanlon, 2011) and by Our Mobile Planet (2012) indicated that the Apple iPhone significantly led the Australian smartphone market at the time of development.

7.3.1 APPLICATION DESIGN PROCESS

To design the application, a scenario-based iterative design process was used. Scenarios are narratives that describe how target users may engage in particular activities (Carroll, 1995). Scenarios in this case were created to help to illustrate different contexts and activities that may occur that the application could support. A persona was created for each scenario based on target user demographics. The People, Activities, Contexts, Technologies (PACT) framework was adopted to analyse the scenarios and also to help describe the domain (Benyon & Macaulay, 2002). The design was also influenced by the application review, with key features from some of the higher-rated applications being used.

PERSONAS

- Sally is nearly 17. She received her Learner drivers licence a month ago and practises regularly with her mum. She tries to fit in as much practice as possible, driving to school everyday and to sport practice. Sally does not own a smartphone but her mum owns an iPhone 4 and lets her download and use apps on it when she wants.
- Daniel is 19 and is in his first year of university. He has no real motivation to get his licence but his mother is encouraging him to get it so he can become more independent and help drive other members of the family. Daniel owns a new generation iPod touch.
- Mary is 22, and is in her fourth year of university. She primarily uses public transport but would like her licence so she can have some freedom and be able to use the car to visit friends or go shopping. Mary often takes lessons with accredited driver trainers as well as with her parents when they can spare the time. Mary owns an older generation 3GS iPhone.
- At 26, Anthony is a mature-aged learner driver. He does not practise regularly; usually only once a month with his partner, who has had his licence now for some time. Practice is usually unplanned, motivated by the opportunity of some spare time available during the day. He has no great motivation to get his licence soon, except it would be useful to have one. Anthony owns the latest iPhone 5.

SCENARIOS

Scenario 1: Driving to school

Sally is driving to school today with her mum. She gets up early, does some piano practice, eats breakfast and packs her schoolbag. She gets in the car with her mum, borrows her mum's smartphone, opens the Learner Logbook app and presses the record button, then gives the phone back to her mum. She starts the car and drives to school. Once she has arrived, parked the car and turned it off, she gets the phone from her mum, and presses the stop button. She records some of the

things she did, hands the phone back to her mum, kisses her goodbye and then heads off to school for the day.

Scenario 2: Forgot to stop recording
It's Saturday and both Daniel and his mum have nothing scheduled for the afternoon. Daniel's mum decides that he should do some driving practice and wants to take him on a driving trip around the local neighbourhood. Before starting the car, Daniel turns his iPod touch on, opens the Learner Logbook app and presses the record button. Daniel drives around the neighbourhood with his mum for about an hour and then arrives back at home. Daniel stops the car and heads back inside the house to go play video games. An hour later Daniel realises he forget to stop recording. He opens the logbook learner app, presses the stop recording button, edits the recorded information, heads down to the car and checks the odometer and adds it to the recorded entry and also changes the time so it is an hour earlier.

Scenario 3: Driving suggestions
Mary has organised a driving lesson with an accredited instructor. On the day of the lesson the driver arrives at her home and picks her up. She gets into the driver's seat, opens the app before the car has been started and presses the record button. The app reminds her that she has not practised three point turns and reverse parallel parks in a while and suggests she could try one of these skills this drive. She tells the instructor she would like to practice these both today and then puts the mobile phone away and starts the car. Mary drives for an hour, successfully completing a number of three point turns and reverse parallel parks. After finishing the drive she turns the car off, opens the app and stops recording. She also records that she completed a number of three-point turns and reverse parallel park and records how confident she felt doing them.

Scenario 4: Switching from physical to mobile logbook
Anthony has been using the physical Learner Logbook to record his hours. He downloads the app and it prompts him to enter his total hours that he has previously recorded into the app. He enters his data

and it displays it on the app for him. Any newly recorded practice, made using the logbook, will be added to the previous data he has manually entered.

Scenario 5: Personalised Notifications
Anthony has been using the app for a while and has recorded a number of hours using it. However, he drives only about once a month and most of the hours he has recorded have been in very specific contexts, for example, during the middle of the day in fine weather. The app determines that the weather tomorrow will be rainy and notifies Anthony that he could possibly try driving tomorrow to get rainy weather experience. Anthony feels that he is not prepared to drive in rain yet and dismisses the notification.

DESCRIBING THE DOMAIN

To help describe the domain, the scenarios were analysed by considering the people, activities, contexts and technologies involved (Benyon & Macaulay, 2002). These are summarised as follows:

People
The demographic of those learning to drive is diverse. They are primarily young (16 to 18 year olds) but can also be older. Generally speaking, younger people are expert users of technology and mobile devices. Learners may be male or female. Learners may learn to drive in a range of different cars. Supervisors are primarily parents and they may not be adept at using technology and mobile devices. Learners may often undertake practice with accredited learner drivers. These learner drivers will generally have wide range of experience teaching.

Activity
The activity a learner driver undertakes using the application is to record supervised driving hours by entering data before and after a supervised driving practice session has occurred. The purpose of the activity is to record practice and to track the total number of hours and type of practice undertaken. The frequency of the activity will vary based on the practice schedule of the learner driver. Use of the application could range from once a month or less, to five or more times a

week. Because the activity may be infrequent, the application must be easy to learn and use (Benyon et al., 2005). The recording activity begins at the start and end of the practice session. It must be able to run without any input from the learner driver, as mobile phone use while driving is banned. The activity of recording is not safety-critical; however the driving activity is and therefore, the recording process should not interrupt it.

Contexts

The recording activity is likely to happen in a car context, before and after driving occurs. The physical environment of the car could vary depending on the weather outside; it could be hot and sunny or cold and rainy. Driving could be carried out in geographically remote environments where Internet access is slow, or where there is little power available unless the driver has a car-specific phone charger. In terms of social context the activity is undertaken with a supervisor present. Interruptions from the application are unacceptable when undertaking the driving activity.

Technology

Driving practice information can be provided by sensing it automatically, or by having it manually entered by the learner or supervisor. Smartphone technology provides a way to track location and time easily, but may have trouble sensing other driving session information, such as skills undertaken. In these cases, manual input will be required. Output needs to be clear, that the system has recorded the session successfully.

TOOL REQUIREMENTS

Based on the personas, scenarios and PACT analysis, a summary of requirements of the tool was created:

- Need an easy way to record a driving session
    - Not just including distance and time but also activities undertaken while driving (e.g., three point turns and reverse

parallel tasks) and how confident the Learner felt completing these tasks and the driving session overall
- Cannot interrupt the user while a driving session is underway
    - Terms and conditions of using the app on first use
    - Reminder that they should not use the phone while recording
    - Should encourage the Learner to switch to silent mode while recording
- Keep the interface as simple and clear as possible. Use little text and more icons.
- Try not to use too much power because there is little power available in the car
    - Encourage the use of a power adapter for the car
- Need a way to manually add bulk hours recorded before the app was downloaded
    - Prompt on the first open of the app
    - Available in the settings of the app
- Need a way to add single driving sessions if a driving session was not recorded
- Need a way to edit the details of the drive just recorded in case
- Need to support if the app is closed, released from memory or interrupted by a phone call or something else

DESIGN ITERATIONS

An iterative design approach was used to develop the non-gamified application. Three main iterations of rapid prototype development and evaluation were undertaken. The first loop focused on the initial design, the wireframes and obtaining feedback on form and function. Key functions and views were identified, which included an introduction screen (for first time use) that welcomed the user, provided information on how to use the app, showed a disclaimer, and allowed for bulk input of previous hours (day/night/accredited in minutes). Other functions included: providing an overview of driving practice undertaken, allowed users to record a practice session or manually input a previous session, detail all the practice sessions undertaken, provide useful resources, and allow users to adjust various settings. A paper prototype was created that detailed these functions (see Figure 7.1).

Figure 7.1 - Low-fidelity paper sketchers of the logbook application

The paper prototypes were turned into digital mockups (see Figure 7.2).

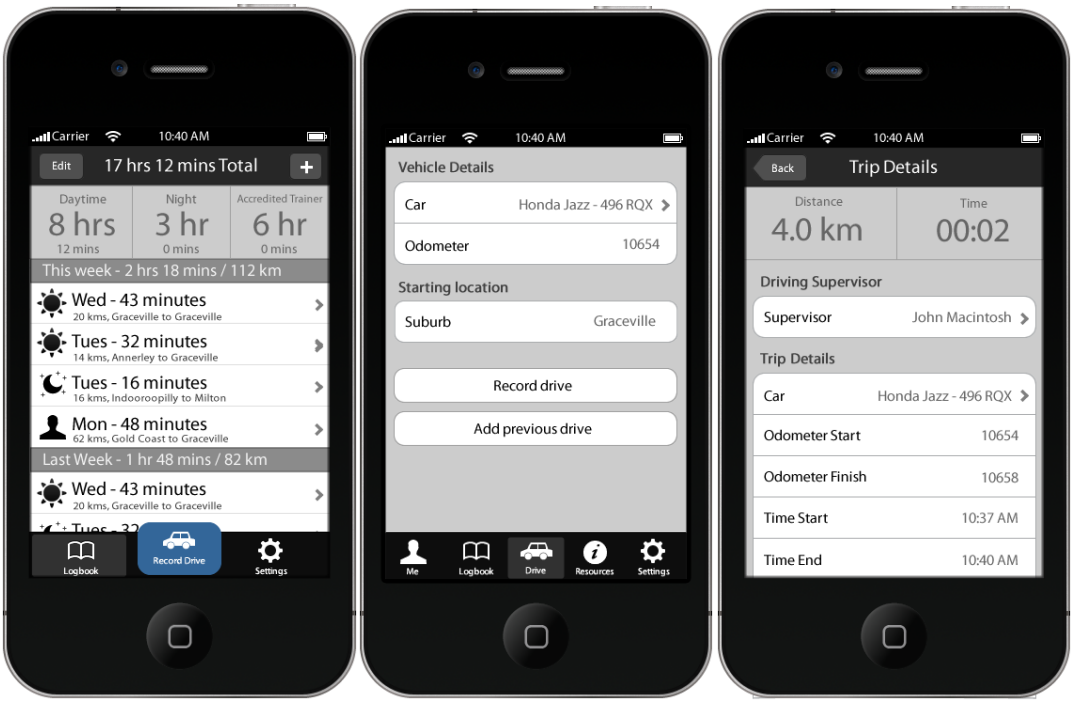

Figure 7.2 - Digital Mockups of the Logbook Application

Different versions of the mockups were created with different layouts and interaction styles. From these, the design of the logbook was iteratively developed through consultation with two mobile application developers. A design was worked out for the logbook application and a working prototype was developed that could run on iPhones and iPod Touches (see Figure 7.3).

The primary features of the working prototype included: recording a trip automatically after entering the starting odometer of the car, reviewing previous trips made using the application, and viewing useful links and information related to learning to drive.

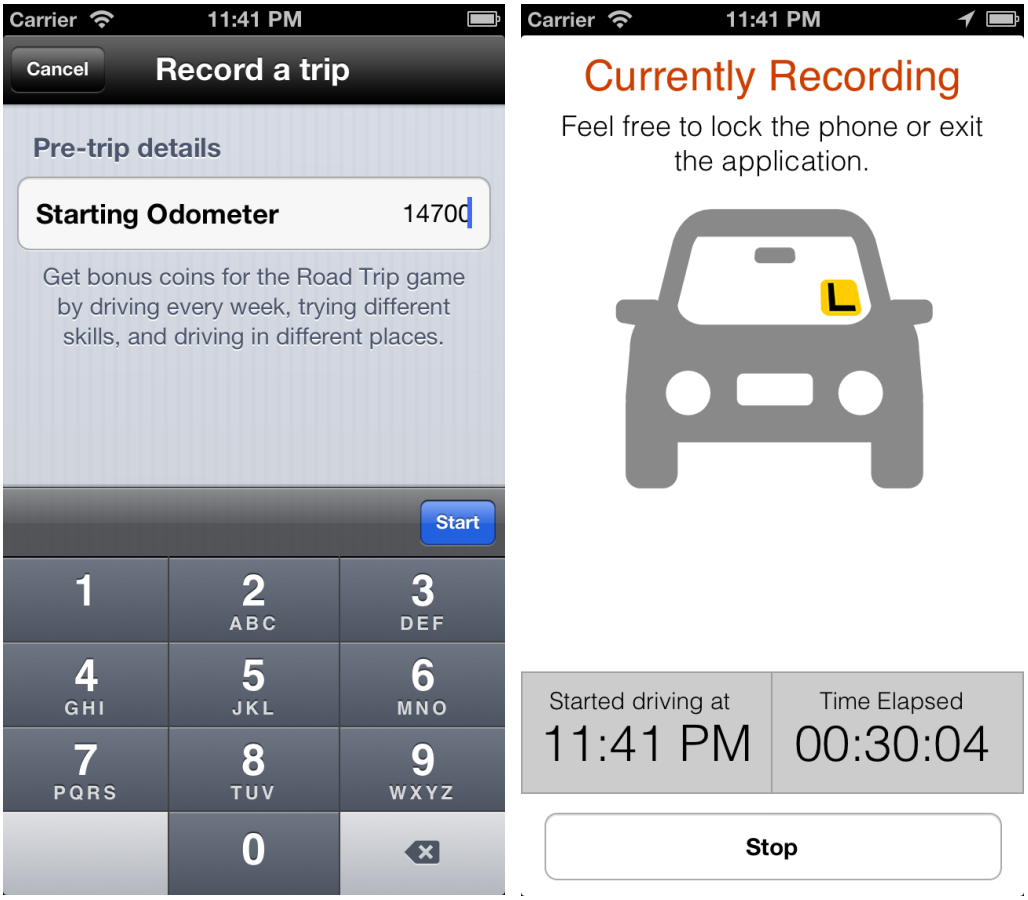

Figure 7.3 - Recording practice views running on an iPhone

The aim of these features was to provide functionality that made logging practice easier than using the physical book. This version of the application was used as the non-gamified control in the field study evaluation. The gamified version used this version as a starting point, and added game elements to it in order that focused on encouraging learner drivers to undertake more diverse driving practice.

7.4 GAMIFICATION DESIGN

A gamification experience was designed for the orientation application using the updated gamification design framework proposed in chapter six (see Figure 7.4).

Figure 7.4 – Updated Gamification Design Framework

These steps were used to develop the gamification experience added to the logbook application. The results of each step of the framework are described in detail below.

7.4.1 JUSTIFY THE MOTIVATION FOR GAMIFICATION

Three steps were undertaken to justify the motivation for gamification: identifying the problem and goals, determining if gamification was worth using, and translating the goals into metrics.

IDENTIFY PROBLEMS AND GOALS

The first step involved identifying a problem, along with the goals that address it. As discussed earlier in the chapter, the problem in this context is to do with younger drivers being at a greater risk of death and injury from road crashes than older and more experienced drivers. Based on the literature and interviews, the goal was broadly identified as encouraging learner drivers to undertake enough supervised practice

to become safe and competent drivers. Specifically, the gamification design should encourage learner drivers to:

- Spread their practice over the learning period
- Continue practising beyond the mandated one hundred hours
- Drive in a variety of different circumstances that become progressively more challenging

DETERMINE IF GAMIFICATION IS APPROPRIATE

There is a possibility that adding game elements to particular activities could result in negative consequences. Therefore, it is worthwhile at this point in the process before designing begins to ask if there could be negative consequences when framing the activity as game-like.

Learning to drive requires concentration and focus from the learner driver. However, the activity is not too serious for gamification. In fact figures indicate that learner drivers are some of the safest drivers, as they are always required to be supervised (Scott-Parker et al., 2011). One important aspect that needs consideration is that there is currently a ban on all mobile phone use (including hands-free) for learner drivers and stage one provisional drivers under the age of 25 years (Department of Transport and Main Roads, 2012). However, as long as the interaction required by the application adheres to these laws regarding the use of mobile phones while driving then there should not be any issues. Currently, the logbook application interaction takes place before and after the learner driver uses the car. Any gamification experience should do this as well, so it does not distract the driver or require the driver's attention while they are learning.

DETERMINE DESIRED BEHAVIOURS

The next step involved identifying desired behaviours that address the goal. Based on the high-level goals in the previous step, specific behaviours can be determined as key performance indicators for meeting these goals. To identify the desired behaviours for each goal, expert interview data was used, along with literature-based evidence. The first

goal was to spread the practice over the learning period, rather than undertake the required practice just before the driving exam. Based on discussion with one expert, if a learner driver was aiming to complete their practice in the minimum amount of time they would need to drive at least two hours each week. Dividing this into two one-hour practice sessions would provide a consistent practice schedule.

The second goal was to encourage learner drivers to continue practicing beyond the mandated one hundred hours. Discussions with experts suggested that some considered the 100 hours to be a crude measure of experience, and that learner drivers may believe that when they reach that milestone they are excellent drivers. Any additional practice beyond 100 hours is beneficial for learner drivers as it allows continual practice in a supervised context. Therefore, the more practice beyond the 100 hours a learner driver undertakes, the better. In this way, the measurable behaviours chosen for this goal began in small increments and increased by larger amounts in an attempt to challenge drivers to reach a larger milestone each time.

The third goal was to encourage learner drivers to drive in a variety of different circumstances. This goal was divided into two specific parts, undertaking different driving skills and driving in different contexts. The list of skills and contexts was derived from a checklist at the end of the physical Learner logbook and a skill list on the Learn2Go website. Previous international research was also referred to that investigated the percent of crashes attributable to deficiencies in specific driving behaviours (McKnight & McKnight, 2003). Those that contributed to above 5.0% of crashes were identified, and where appropriate, were used to influence the choice of measurable behaviours for this goal.

Goal	Measurable Behaviour
Spread the practice over the learning period	Undertake at least two practice sessions a week
Continue practicing beyond the mandated one hundred hours	Undertake more than 100 hours with milestones at 105 hours, 115 hours, 130 hours, 150 hours and 200 hours
Drive in a variety of different circumstances	Complete different driving skills, including: Merging Lanes, Changing Lanes, Turning right across traffic, Entering/Exiting Highways, Turning across traffic, Signalled Intersections, Unsignalled Intersections, Roundabouts, Reversing Exercise, U-turn, Reverse Park, Hill Start, Basic Control. Drive in different contexts, including: Multilane roads, Single lane roads, Heavy traffic, Moderate traffic, Light traffic, Sealed road, Unsealed road, School Zone, Night time, Day Time, Rainy weather, Sunny weather, Dawn, Dusk, Multiple passengers, No passengers)

Table 7.1 – A Summary of Goals and Desired Behaviours

7.4.2 DESIGN THE GAMIFICATION EXPERIENCE

Three steps were involved in designing the gamification experience. These included working out how to measure and enforce the behaviours, understanding the player, and then designing the gamification.

IDENTIFY APPROPRIATE SENSING

Once the desired behaviours were identified, the next step was to find the most automatic and accurate way in which to sense them. The gamification design framework suggests using automatic sensing techniques should be considered first, as they provide the best way to enforce gamification elements. If automatic sensing is unable to successfully measure all the desired behaviours, then alternative crowdsourcing or self-enforcement techniques can be explored.

Devices that support iOS (iPhone, iPad and iPod touch) have a range of different sensors available for use. In terms of physical sensors, location information can be accessed through the use of the phone's Global Positioning System (GPS) sensor, cellular and Wi-Fi sensors. Virtual sensors available included sunset and sunrise data to determine if a learner driver was driving during day or night. Weather data could also be sourced from the Yahoo Weather API, which provided location-specific weather information to help determine what conditions a learner driver was practising in. These sensing cues were combined in order to be able to automatically sense some learner activities. Remaining activities such as undertaking various driving skills and driving in various contexts could not be sensed automatically, but could be manually enforced by the supervisor and learner driver (See Table 7.2).

Automatically enforced using Smartphone technology	Nighttime, Day Time, Dawn, and Dusk driving contexts can be measured using the clock and sunset/sunrise data sourced from the internet for Brisbane.
	Weather conditions can be sourced from the Yahoo Weather API based on smartphone location and time.
	Number of weekly driving sessions can be obtained automatically by searching and counting the driving practice sessions recorded
	Total practice hours can be obtained by automatically searching and counting driving practice time over all the sessions
Manually enforced by the supervisor/learner driver	Driving skills will need to be recorded by the supervisor/learner driver for each practice session
	Remaining driving contexts will need to be recorded by the supervisor/learner driver for each practice session

Table 7.2 – Strategies for measuring and enforcing the metrics

These available sensed actions will serve as a basis for creating a gamification experience.

UNDERSTAND THE PLAYER

Before designing the gamification, the target player demographic was identified. In terms of age, the primary audience for this application covers two groups. The first are older teen group (aged 13 to 18) and the second is the young adult group (aged 18 to 24). The teen is getting ready for adulthood; there is generally a divergence between male and female interests, with boys tending to focus on competition and mastery, and girls focusing on real world issues and communication. They both may also be open to trying new kinds of experiences as well (Schell, 2008). Young adults on the other hand generally have established tastes when it comes to games. Additionally, there are likely to be a few players older than 25; for these players it can be harder to find time to play and they are more likely to be casual game players (Schell, 2008). Based on these demographics the gamification will need to appeal to a wide range of players. It should be fairly casual – not target a specific demographic. The theme of the experience should be general as well, so as to appeal to the wider range of players.

DESIGN THE GAME

Once the target players had been identified, the gamification design process began. The gamification design went through a user-centered, iterative design process. The same design principles used to design the non-gamified version of the application had to be adhered to for the gamification design as well. In particular this meant that the gamification experience must not be used while learning to drive, and therefore had to take place either before or after the learner driver had completed a practice session with a supervisor. In a similar way to the orientation application, achievements could simply have been added that reward learner drivers for completing specific driving activities. However, one of the changes proposed in the updated framework was to look at how game elements could be used to try and make the desired behaviour more intrinsically motivating, rather than having reward-based game elements alone that may promote extrinsic motivation. In this way, undertaking practice could become a central mechanic in a larger game

experience, instead of just rewarding the player with badges at certain milestones.

A number of ideas and themes were brainstormed based on the desired behaviours and player demographics. Initially the design was influenced by *Zombies, Run!*, where the first idea was to have players drive to different locations to pick up supplies to bring back to base. A second idea was to have drivers go out and try and find treasure, where different routes would reveal different items. Although potentially interesting ideas, they were not as closely tied to the action of driving as they could have been and were the theme was not general enough for the target player demographic.

The idea of the learner driver undertaking a virtual road trip around Australia was settled on as the basis for the gamification experience. A road trip is something often associated with the primary target demographic, where it can be a coming of age activity that young people may often undertake when they attain their license (Tourism Australia, 2014). Using a road trip theme also provides a clear goal for the gamification – make it all the way around Australia – as well as smaller subgoals such as visiting the states of Australia, and also visiting particular towns and tourist attractions within these states (see Figure 7.5).

This theme tied nicely into the real world, providing a simplified model of a road trip, and also linked to the driving practice undertaken by learners. An additional bonus was that completing a realistic road trip around Australia would take approximately 200 hours to complete, potentially encouraging learner drivers to undertake more than the mandatory 100 hours of driving practice.

Figure 7.5 - Australia's National Highways (Wikimedia Commons, 2007)

Using this idea, a gamification design document was created (similar to a game design document) where the story, mechanics, goals, rules, challenges, actions, feedback, player strategies, and aesthetics were outlined and evolved over time. It was also noted in the document how different game elements support the design requirements identified earlier and also how they could be used to support autonomy, relatedness and antecedents of flow. Highlights from the document are detailed below.

Game Story

The story was based on players choosing some friends and undertaking a virtual road trip around Australia with them. Road trips are often seen as appealing to younger people, representing aspects of *independence, freedom,* and *fun*. The road trip theme was also used in the Queensland Learn to Drive website (Queensland Government, 2011), which reinforces its use in this context.

Using a road trip theme also provided a clear goal for the player: make it all the way around Australia. This goal also led to smaller sub-goals, which included visiting states and towns along the way.

Using a road trip aligned well to the amount of time a learner practices, as an entire trip around Australia would take approximately 200 hours to complete. This may encourage practice beyond the mandated 100 hours (DR5).

Game Mechanics

The mechanics of the game revolved around players selecting a car, choosing a nearby destination, and then each time they undertook practice they were rewarded with coins. Coins were rewarded based on frequency of practice (DR4), the total trip time (DR5), and the choice of skills and contexts completed during the trip (DR6), such as U-turns and reverse parallel parks. These coins could then be used to purchase different amounts of fuel, as well as other items (e.g., repair kits and spare tyres), to help advance the player around Australia. Buying fuel directly translated into driving a certain number of kilometers, determined by the type of car the player had chosen. As players completed the virtual road trip they could visit new towns and cities in Australia and unlock interesting information about these locations, such as local tourist attractions.

Players could choose their next destination on the road trip. Some of the destinations were quicker to reach but were more dangerous to travel, whilst other destinations took longer to reach but the journeys are considered to be less risky. A player's car might break down and if this happened then players had to pay for repairs. Players could also choose from different cars with different characteristics, for example the *Van* was less reliable and broke down often, but could travel further on less fuel. Changing cars regularly was an integral strategy when travelling different routes around the virtual road trip.

Colorful and playful aesthetics were used that were non-gender specific in their design. Feedback and interactive elements such as buttons were based on real-world road sign designs. The road trip also included ac-

tual photos from each location visited around Australia. These began as blurry images and as the player drove closer and closer to the destination they became clearer, linking the trip to the real world (see Figure 7.6)

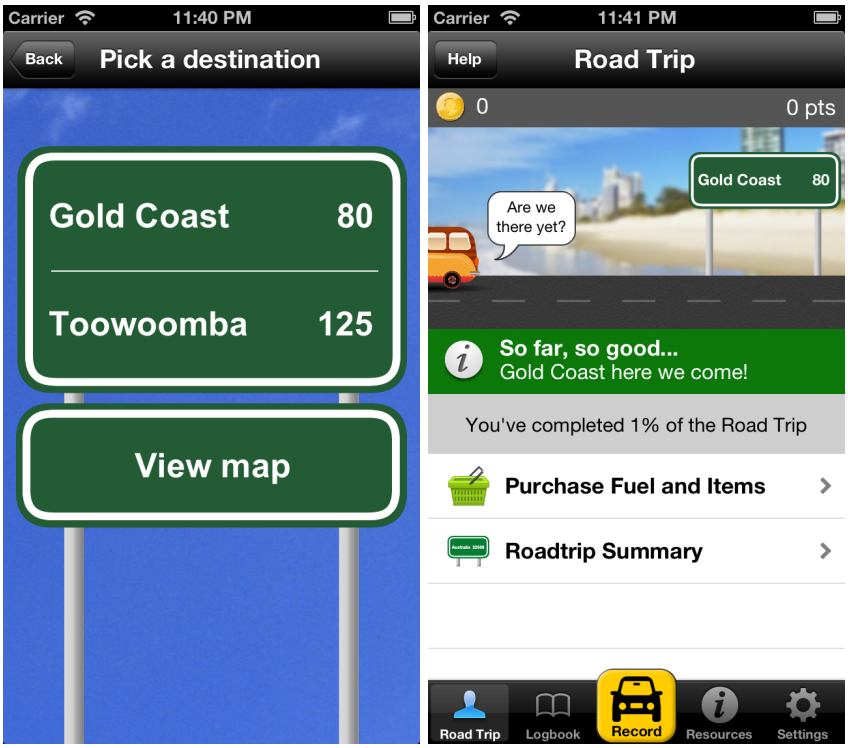

Figure 7.6 - Road Trip Game Views – signs and destinations

The detailed mechanics of the gamification design are outlined below in terms of goals, rules, challenges, actions, feedback, flow, and relatedness.

Game Goals

- Primary Goal:
    - Complete a road trip around Australia where you visit different states and territories of Australia and then make it back home
- Sub-goals:
    - Visit available states, capital cities and towns
    - Unlock all the cars
    - Keep the people in your car happy
    - Get the highest score amongst all your friends

Game Rules

Outlined below are potential rules for the game. Following each rule in *italics* is the way in which the rule aligns to the design goals. **Green** text explains how the rule supports motivation and the game experience.

- The player receives coins for every kilometer that they drive in real life. These coins can be used to buy fuel, which will advance the player along the virtual road trip. (***Encouraging driving beyond the mandated one hundred hours***) (**Clear goals and feedback**).
- The player receives extra coins depending on how diverse their real practice session is in terms of regularity and the skills undertaken during the session (***Spread the practice over the learning period*** and ***Drive in a variety of different circumstances***) (**Challenge**).
- The player will randomly receive items that will help them out on the way (**Unexpected rewards**), or they may buy them using their coins (e.g., spare tyres, phone a friend, snacks etc.).
- When the player reaches a new city they receive interesting information about that city and a blurry image of the city is revealed (**Reward** and **Progression**).
- Players can choose which city they would like to travel to next. The player receives a postcard and a set number of points for reaching a new city (e.g., 100 points) and then bonus points are awarded based on the distance travelled to that city (e.g., 400km = 400 bonus points). The longer the road the more points, but there is a greater chance a breakdown might occur (**Autonomy** and **challenge**).
- The player may occasionally breakdown depending on the type of road chosen to travel. If this happens the player has to pay some coins and answer a driving-related question to fix their tyre. Otherwise they could use an item if they have one to fix the tyre (e.g., spare tyre) (**Challenge**).
- The player needs to buy snacks and music CDs for the people in their car otherwise they will become upset and slow the trip down (**nurturing**).

- Different cars have different attributes (reliability, speed, or comfort) (**customisation**, **collection, strategy** and **autonomy**).
    - The player starts with a choice of three cars with different attributes
    - Players can purchase cars with different bonus attributes
    - Players may also unlock special cars by reaching certain milestones
    - Players need to choose a car that is appropriate for the type of road they are travelling on, or for the player they are (e.g., someone who is not interested in looking after their passengers might use a car with high comfort)
- If players have friends who are using the same application, then the player is able to see and compare their progress (**relatedness, competition**).

Game Actions

The actions that a player can undertake within the game include:

- Record/input practice
- Complete a challenge while practising
- Use a purchased item
- Choose the next location
- Choose a different car

Game Challenges

Questions that a player may ask when playing the game:

- What is the best strategy?
    - How can I travel Australia in the shortest route?
        - What kind of practice gets me the most distance each trip I record?
        - Which car is the best to pick?
    - How can I travel Australia and get the most points?
        - What gives me the most points each trip I record?

Game Feedback

Feedback that the player receives in the game includes:

- Number of coins rewarded for a practice session
- Why coins were awarded for each practice session
- Next town name
- Distance to next town
- Fuel needed to reach next town
- Current distance per litre of fuel consumed
- Current mood of passengers
- Current car information (working or not working)
- Number of points obtained
- Number of postcards obtained
- Picture of the next town becoming less blurry the closer they get to the town
- Number of states visited
- How close a player is to completing their road trip

Aesthetics

In terms of aesthetics, a mix of vector cartoons and real imagery can be used to cater to the target player demographic, and to align with the goals of the application. The graphics were therefore chosen to be gender neutral and not too childish. Simple, royalty-free, cartoon cars were found that could be used to represent the vehicles players could choose on their road trip (see Figure 7.7).

Figure 7.7 - Examples of the car icon set used (Iconfinder, 2010)

In order to add a little fun, feedback, and surprise to the game, speech bubbles were placed above the car and random text was shown from the car passengers, providing statements such as *"Are we there yet?"*, *"I'm bored"* and *"Woo, road trip!"* These were also used to give feedback on the current state of passengers.

For each destination on the trip, real photos were used for the towns and cities. These images began as blurry images; as the player got closer and closer to their destination, the images were slowly revealed. This reinforced the distance remaining to the destination, provided a reward when revealed and also linked to the metaphor of a destination becoming clearer in real life the closer a person gets to it.

PROTOTYPE DEVELOPMENT

Iterative prototype development then began, using the game design document to guide the development of a low-fidelity prototype. Paper prototypes were made and these were turned into digital mockups (see Figure 7.8).

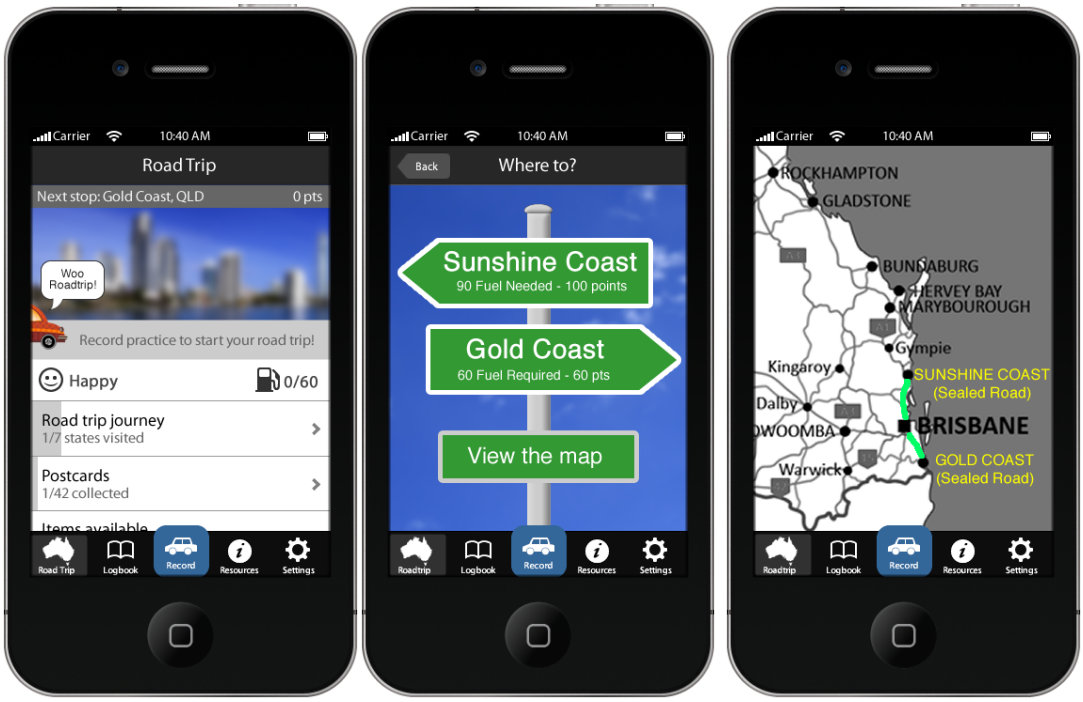

Figure 7.8 - Early mockups of the road trip gamification

Different versions of the mockups were created with different layouts and game elements. From these, the design and look of the gamification was iteratively developed (see Figure 7.9).

Figure 7.9 - Digital mockups for the virtual road trip

The design was then implemented as a prototype that could run on iOS devices, such as iPhone, iPod Touch and iPad (see figure 7.10).

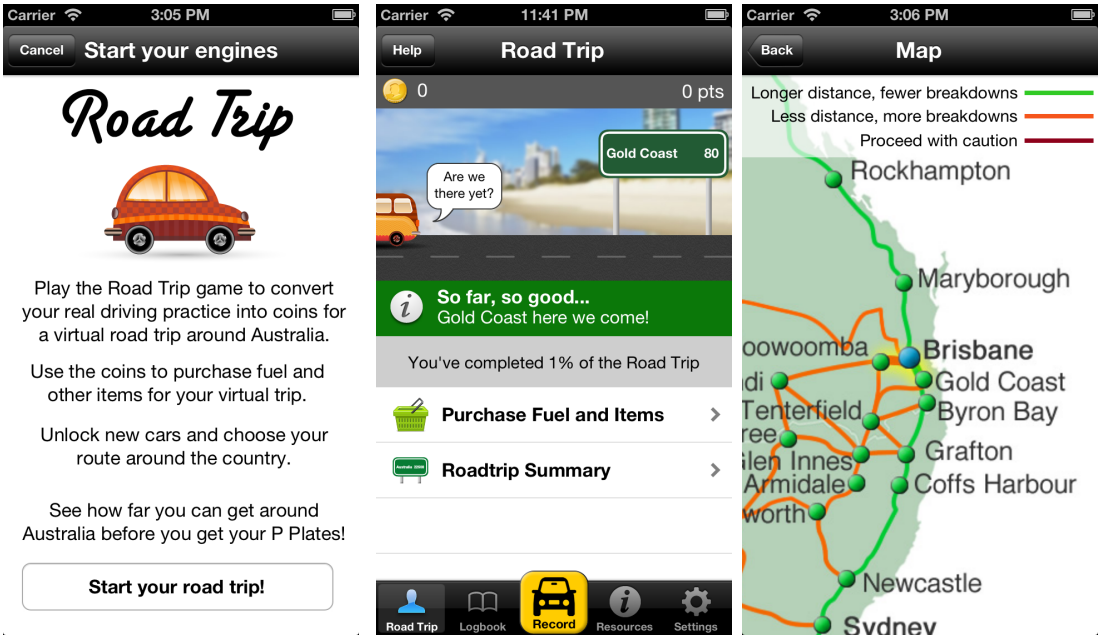

Figure 7.10 – Screenshots from the first virtual road trip prototype for iOS

The gamification design evolved from that initially proposed in the gamification design document. The final design was still based around players undertaking a virtual road trip around Australia. They were asked to enter their name, and the name of up to three passengers they wanted to take on their road trip. Players could then choose their first destination and also pick the car they would like to use on the road trip.

Players could choose from three available cars. The other seven cars were locked and required the player to unlock them by undertaking certain tasks (such as reaching a new city). Each car had various qualities that could affect gameplay, such as efficiency, which affected how far a car travelled on the amount of fuel provided; reliability, which affected how often a car broke down and had to be repaired; and comfort, which affected how happy the passengers were.

As players undertook real-life practice they received coins, which could be used to buy fuel and items to help their progress on their road trip. Bonus coins were given when players undertook different skills, drove in different contexts, or practiced regularly.

Depending on the type of car and route chosen in the virtual road trip, a negative event could occur, such as getting a flat tyre (see Figure 7.11) or a passenger getting carsick. Players would need to attend to these issues by purchasing appropriate items before they could continue on their road trip. Items available for purchase included fuel, to add distance to a player's road trip; a spare tyre, to repair any flat tyres; medicine kits, to heal passengers; and CDs, to keep passengers happy.

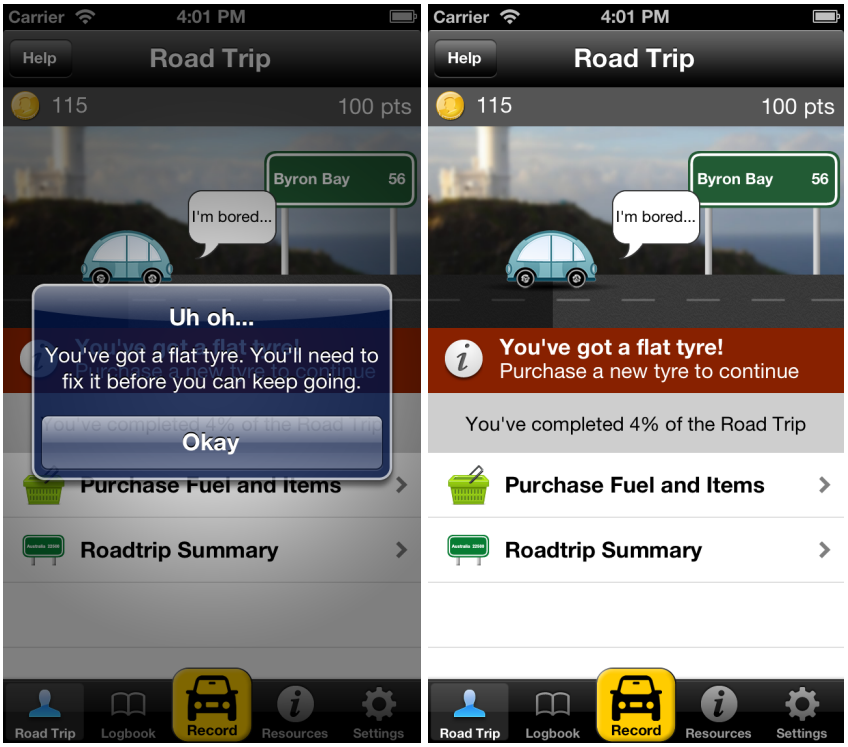

Figure 7.11 - Getting a flat tyre in the gamification prototype

7.4.3 EVALUATE THE GAMIFICATION EXPERIENCE

The prototype evaluated by identifying and addressing any gamification issues, running a usability and playability study, and making changes to the prototype, based on feedback.

ADDRESS ANY GAMIFICATION PROBLEMS

An expert review of the road trip gamification design was undertaken using the six heuristics outlined in the gamification design framework. To do this, the gamification design was reviewed to try and identify if any of the six potential issues existed:

1. Goal Alignment: The primary goal of the game was identified as completing a road trip around Australia and the best strategy in the game requires the player to undertake regular and diverse practice in real life to complete this, as well as practising beyond the mandatory 100 hours. This aligns with the desired behaviours.

2. Enjoyment: The game was designed for the target audience and also addressed aspects such as challenge and skill in the game design document. This is likely to lead to a more enjoyable game.
3. Engagement over time - Creating a gamification design that engages players for a minimum of a year is a challenge. A long-term goal was provided (finish the road trip), along with a series of smaller goals (reach the next city or town, upgrade the car). Also, the fact that interaction with the game is kept to a minimum (before and after a real practice session) may encourage engagement over a longer period of time.
4. Distractions: Minimum interaction is required by the gamification design, which reduces distractions. Players interact with the game elements briefly after a practice session has been recorded and then can choose to engage with it at any other time.
5. Cheating: The design needs to further address ways in which players could cheat, as manually entering false trips at the moment could allow learner drivers to advance in the game. They could then delete these trips afterwards. Suggestions to fix this could include allowing only trips recorded using the record feature of the application to be counted towards the road trip. Also, any deleted trips should maybe reverse the road trip progress.
6. Dangers: The gamification elements are accessible only when a learner is not driving – appearing after practice has been recorded. This should reduce any dangers and also adhere to the strict driving laws regarding mobile devices.

The results of the review suggested that cheating could still be an issue with the design. To address this changes were made to only allow recorded practice to be counted towards the virtual road trip.

EVALUATE AS A TOOL AND A GAME

Twelve recent learner drivers were recruited to participate in a combined usability and playability study to provide feedback on the gamification design and provide an initial comparison between it and the non-gamified version.

The aim of the study was to:

- Evaluate subjective usability, playability and potential motivation of the gamified version.
- Compare preference, user experience of the gamified version to the non-gamified version in terms of learnability, satisfaction, enjoyment, and motivation.

A 45-minute laboratory session was held during which participants tried the two versions of the application. Participants completed a questionnaire recording demographic information (age and gender), technology experience (technology videogame usage), and driving experience (experience of learning to drive and with the physical logbook) before beginning the study. Participants were then presented with one of the two versions of the application, chosen in a randomised counterbalanced order to address sequencing issues. Participants were asked to perform tasks that used all the functions of the application. For the non-gamified version participants recorded a practice session, edited the practice session, and manually entered practice. The same tasks were used for the gamified version, except that the manual practice entry task was replaced by a task that required participants to purchase fuel for the road trip. Screen interactions were recorded automatically on the phone using the tool Capture Record[1] and the researcher made observations. Audio was recorded during the study, as the participants were encouraged to think aloud. Answers to the interview questions asked by the researcher were also recorded.

[1] https://github.com/gabriel/CaptureRecord

A questionnaire was administered after the participant tried each version of the application. Questions asked the participant to report on whether they enjoyed using the application, if using the application was fun, if using the application was frustrating, if they had to think hard to use the application, if they felt the application was useful overall, and if they could easily work out how to use the application. They were also asked if the following functions were useful: record a drive, logbook, and resources. Finally, participants were asked if they thought the application would be useful for a learner driver. Questionnaire responses were given on a five-point Likert-scale, where a response of 1 was Strongly Disagree and a response of 5 was Strongly Agree.

This process was repeated with the other version of the application. After participants tried both prototypes, they completed a final questionnaire that asked them to compare each prototype in terms of preference, enjoyment and motivation. The participant was then asked to play with the gamified version for another five minutes. Following this a playability questionnaire was administered, which asked if they found the game elements enjoyable, what they liked and did not like about the gamified application, and if they had any improvements they would like to see. A brief unstructured interview was then undertaken that probed for any further playability feedback, or suggestions for improvement.

A statistical analysis was undertaken on the quantitative data using Wilcoxon Signed Ranks Tests to compare Likert-scale questions, and chi-square goodness-of-fit tests for version comparisons. Short-answer questionnaire responses and interview audio was also recorded, coded and themes were identified.

Overall, participants reported that the gamified version was more engaging and motivating than the non-gamified version. However, neither version was reported as being significantly preferred over the other. This may have occurred due to the novelty factor of both applications compared to the physical logbook, or because of a number of usability issues that arose in the gamified application, namely an in-

creased difficulty in learnability. Addressing these design issues is an important consideration before the application is tested in the field experiment. A summary of the study's findings can be found in Table 7.4.

Measure	Result
Learnability	Results suggest that the gamified logbook was harder to learn than the regular logbook (Z = -2.081, p = 0.037)
User Satisfaction	No significant difference measured between the two applications – possible ceiling effect occurred
User Preference	Neither applications were preferred over one another ($\chi^2(2) = 1.333$, p = 0.248) but both were preferred over the physical logbook ($\chi^2(2) = 8.333$, p = 0.004)
User Enjoyment	Results suggest the gamified logbook was perceived as more enjoyable than the regular logbook ($\chi^2(2) = 5.333$, p = 0.021)
User Motivation	Results suggest the gamified logbook was perceived as more motivating than the regular logbook ($\chi^2(2) = 9.500$, p = 0.009)

Table 7.3 – Summary of results from the usability and playability study

Only one usability result proved to be significantly different between the applications: participants reported that they found the gamified application harder to *learn how to use* than the non-gamified version. Apart from this result, no other significant differences were found between the two versions. This may indicate that participants found both versions to be equal in terms of usability (apart from learnability). However, it is noteworthy that the majority of the mean scores for each version were relatively high (above 4, or *agree*) for 14 of the 20 results. These high mean values may suggest that a *ceiling effect* occurred (i.e., bunching of scores at the upper level reported by the instrument), which could be due to the novelty of both versions of the application when compared to the physical logbook.

The learnability result indicates that the gamified version of the application was harder to learn to use than the non-gamified version. It is interesting to note that although an introductory screen provided an overview of how the gamification worked, a number of participants ignored it. Five participants skipped it completely and four participants

spent only 7 to 10 seconds reading and synthesizing the information on it (unfortunately data wasn't recorded for the remaining three participants due to an error with the screen recording tool). It was observed that participants generally opted to take a more exploratory approach to understanding the game elements, with the majority of participants attempting to try to tap on different parts of the game screen to learn what was, and wasn't, part of the game. Participants reported that the gamification was difficult to understand initially. However, once they had completed tasks involving recording practice, receiving coins and buying petrol, the participant's understanding of the game elements became much clearer.

A number of playability issues were identified in the gamification design. Some users had trouble grasping how the game elements worked without first recording a practice session. During the tasks some participants indicated a sense of confusion; "*So I'm not sure what I'm meant to do now"* and *"at this point, I'm not sure what to do. I'm here and I don't know what to do*". Some participants had difficulty discerning between the game and the logbook functions *"Are we actually going to the Gold Coast, or is it a game?"* Some participants also felt the gamification experience was too short: it "*doesn't engage the user for more than a few seconds*" and "*overall it was an enjoyable application, the game element was rather short*". A number of participants thought the addition of game elements might encourage more cheating due to their game-like nature: "*I can see people putting, you know, they've done every hill start, U-turn, three point turn in every drive so they can get more points*", *"so there might be an incentive to cheat instead of using it for your own advantage"*, and "*it may lead to more forging of trips*".

A number of participants provided ideas for improvements and additional game elements, including the addition of a more in-depth tutorial, an achievement system, and competitive elements. A few participants suggested the gamification experience should take less precedence over other functions; *"Focus a little less on the virtual side of the app, since learning to drive is a practical experience, I wouldn't want to be spending time doing virtual activities.*"

The small sample size (n = 12) was a limitation of the study. However, these early results provide some positive indication that the functions of the application are useful, and that both versions of the application are preferred over the physical logbook. These results also indicate that the gamified logbook could potentially be more enjoyable and motivating than the regular logbook. The current gamification design clearly adds a level of complexity to the application that needs to be addressed. These results indicate the importance of running a playability study. Without it, a confusing gamification design would have been delivered.

BALANCE THE TOOL AND THE GAME

The final step of the framework is to make changes to the gamification design based on the results of the study. A number of usability and playability changes were recommended and made, using these results. These included making improvements to the gamification mechanics and user interface, such as providing further guidance to introduce players to the gameplay, adding achievements and minor competitive and sharing features, reconsidering the design and layout of the main gamification interface and adding further functionality to prevent cheating.

The other recommendation for the gamification design was to try to simplify the fuel and coin metaphors currently being used in the gamification design, and also to focus on supporting the functionality of the application first, and the gamification second. To address this a large change was made to the primary game mechanic. Instead of collecting coins to buy fuel, it was decided that the metaphor would be simplified and for every one kilometer a learner driver drove in real life, one kilometer would be added to their road trip distance. This would make it simpler and easier to understand. Learner drivers would still receive bonus coins for undertaking diverse practice, which could be used to buy upgraded cars. This way, the game mechanics was simplified, but was aligned better to the gamification goals.

7.4.4 PROTOTYPE DESIGN FOR THE FIELD EXPERIMENT

The changes were made and the final application was ready for a field study evaluation. The final functionality included an introduction, a logbook summary, a record practice function, the road trip game, and a settings view. These functions are summarised below.

INTRODUCTION

The introduction provides an overview of the functions available and details on the road trip feature (if it is the gamified version). In addition to this the user can enter any previous practice they may have recorded already in their physical logbook. The user is also required to read a disclaimer and warning, and then accept the terms and conditions of the application before they can use it.

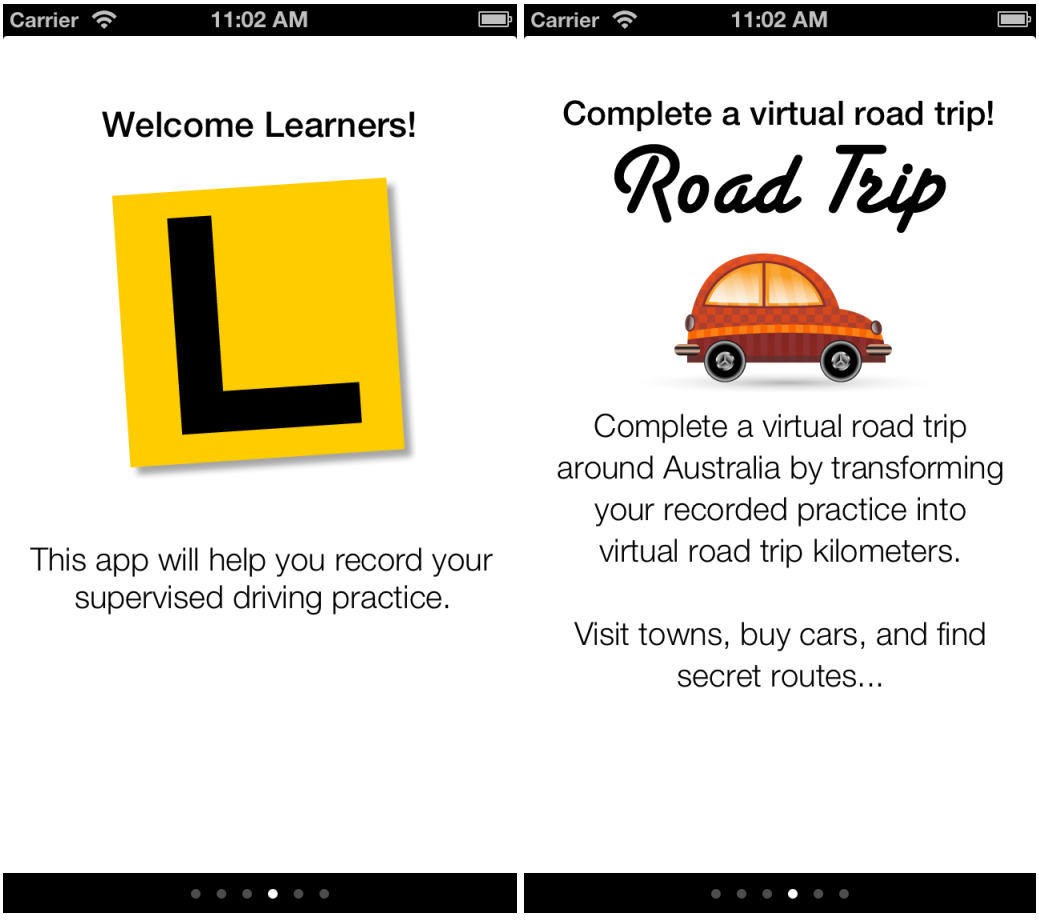

Figure 7.12 – Introduction views

LOGBOOK SUMMARY

The logbook view, the first screen the user sees after the introduction, provides an overview of the total amount of practice logged using the application. Underneath the total is a list of each practice session logged, with the most recent session at the top. Clicking the total number of minutes logged will take the user to a practice breakdown view.

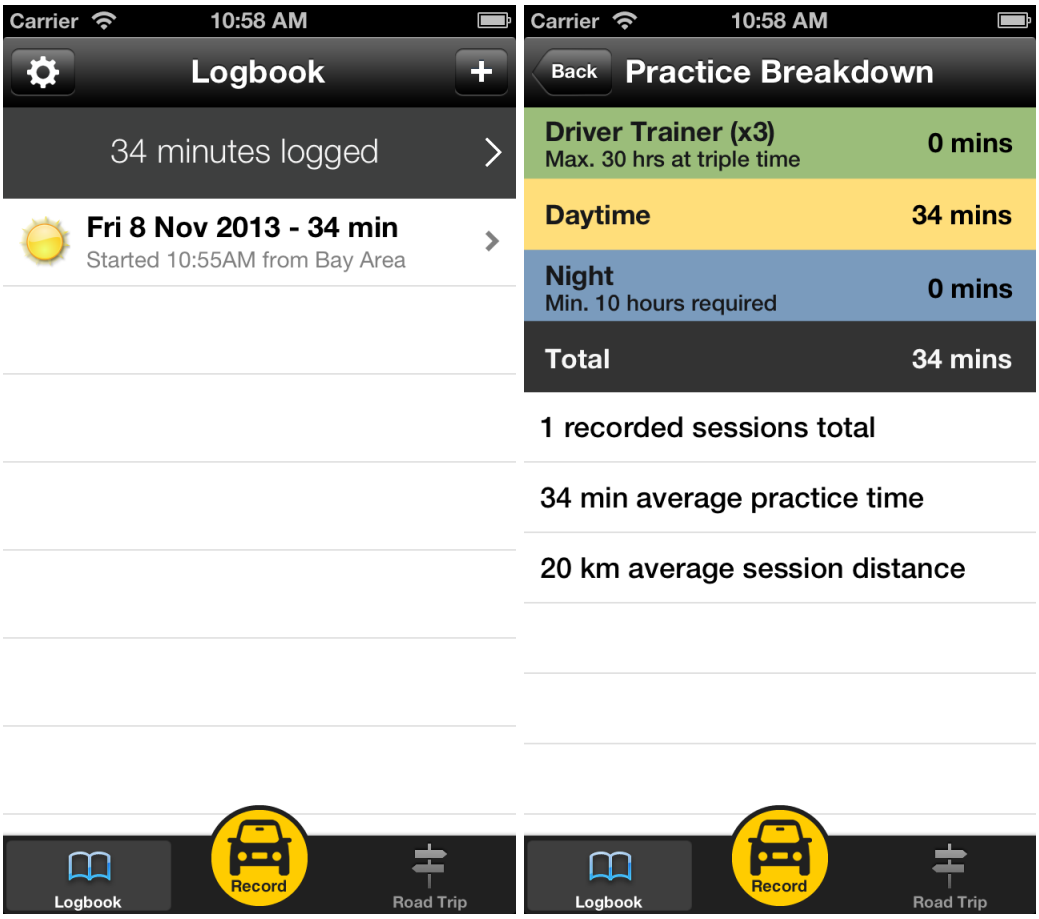

Figure 7.13 – Updated Gamified Logbook Design

THE RESOURCES AND SETTINGS VIEW

The settings and resources view can be accessed using the button in the top left corner of the logbook summary view. The resources view provides a list of useful resources, as well as settings that allow the user to export their logged practice data, provide feedback or view the introduction to the application again.

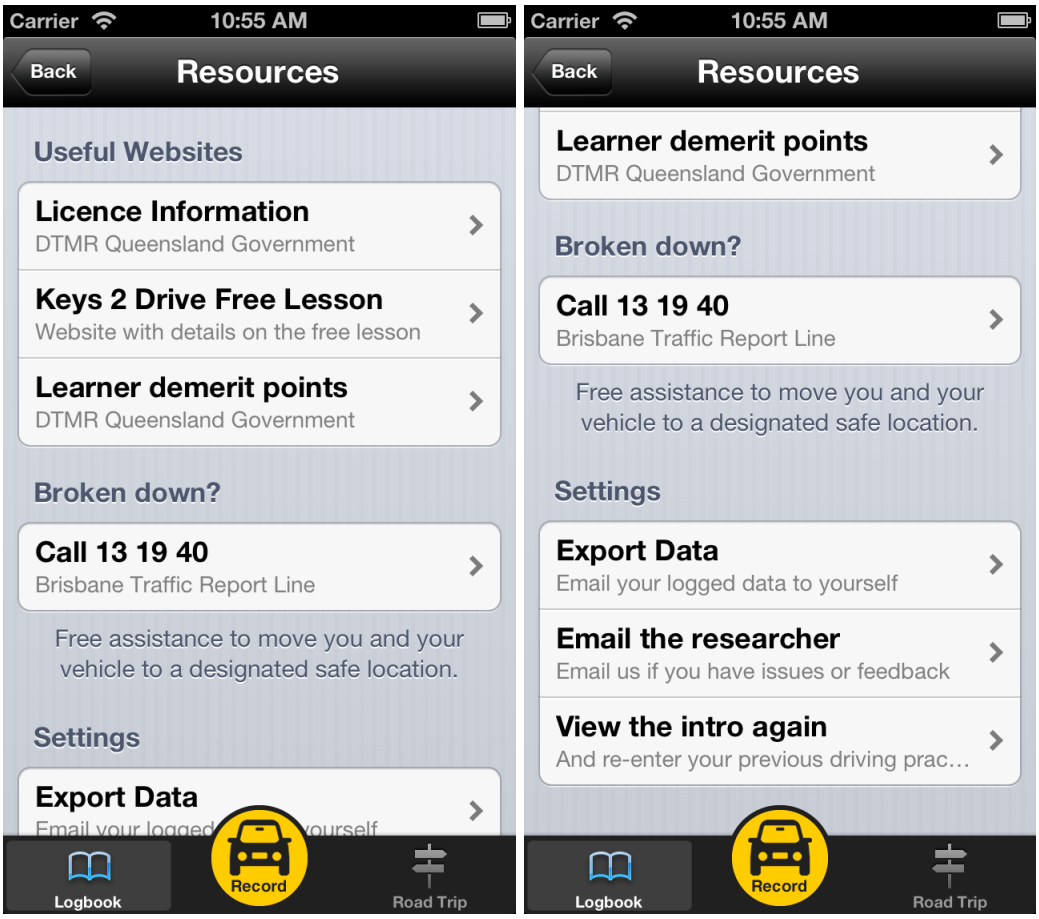

Figure 7.14 – Resources and Settings View

RECORDING A TRIP

Users can click the record button at any time to begin recording their practice. They just need to enter the current odometer reading of the car they are driving and then the application will start to record their practice.

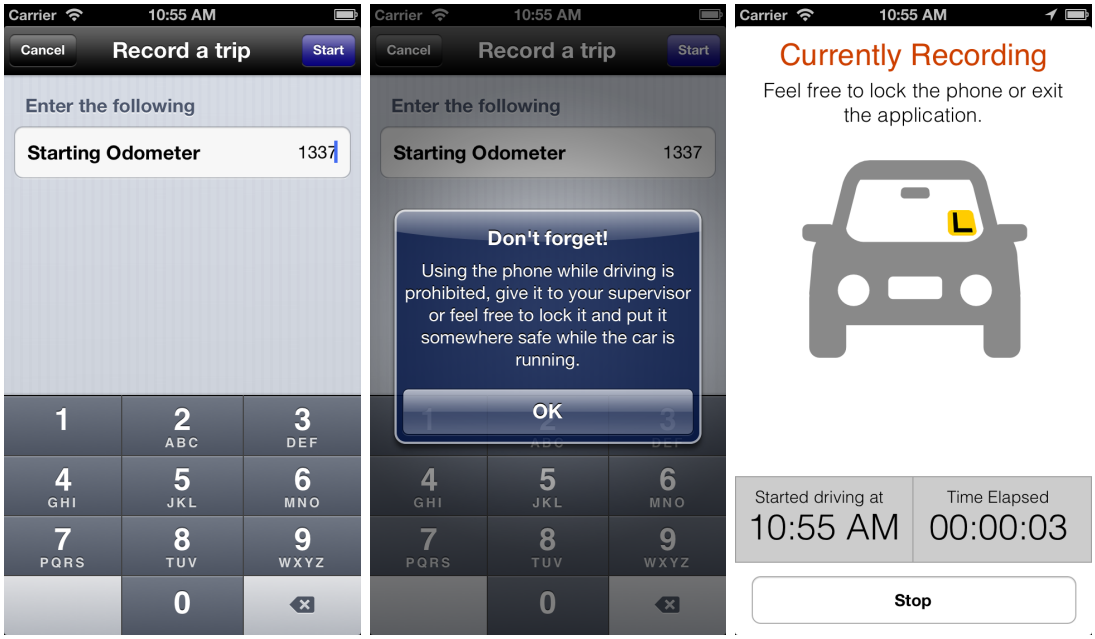

Figure 7.15 – Recording a trip

Once users have finished practicing, they can click the stop button and then enter the vehicle details, current odometer reading, and supervisor for the practice session. All the other information is entered or calculated automatically. Any required fields that have not been filled out are highlighted red. Supervisor and car details are saved to make entry easier.

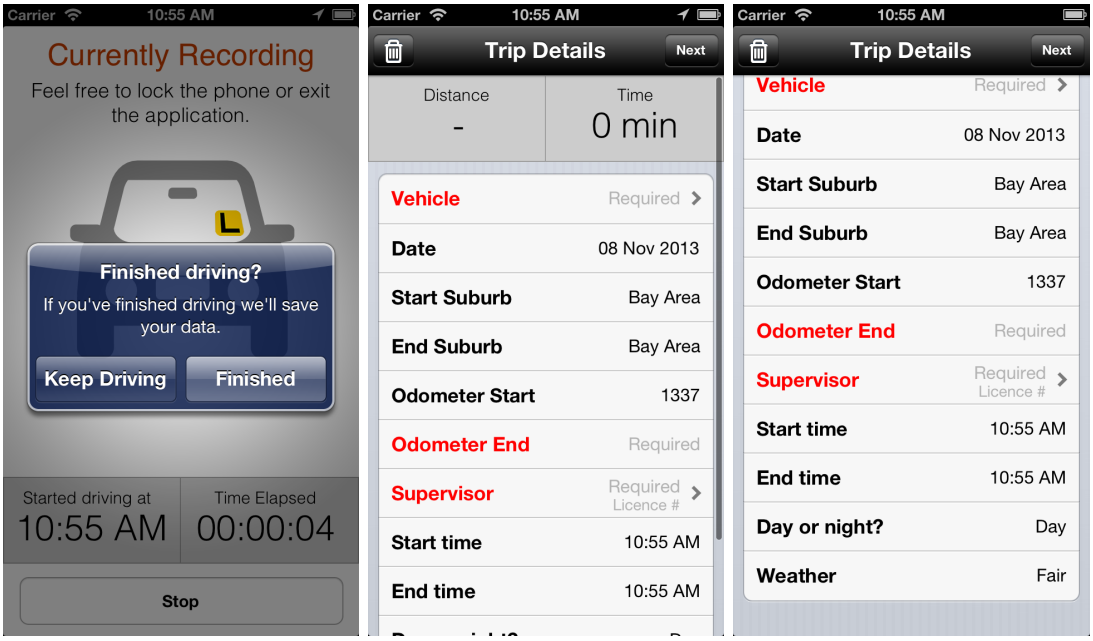

Figure 7.16 – Updated trip details layout

VIRTUAL ROAD TRIP GAME

The gamification experience designed for the application revolved around the learner driver undertaking a virtual road trip around Australia. The design was updated so that for every kilometre in real life the learner practiced, one kilometre was added to their virtual road trip. Learners also received bonus coins for undertaking regular and diverse driving practice. These coins could be used to upgrade their car. If the learner had any other friends using the application then they could see their progress on the virtual road trip as well. Learners could also unlock driving achievements and choose their road trip route around Australia.

POST-PRACTICE ROAD TRIP VIEW

After a learner completed practice in real life, a virtual road trip screen was shown. This showed the learner's car travelling to the next destination on the road trip, along with a break down of bonus coins they had received. If they did not get any coins, information was given to the user telling them how they could get coins on the next trip. If the user unlocked an achievement, then this was displayed using an alert.

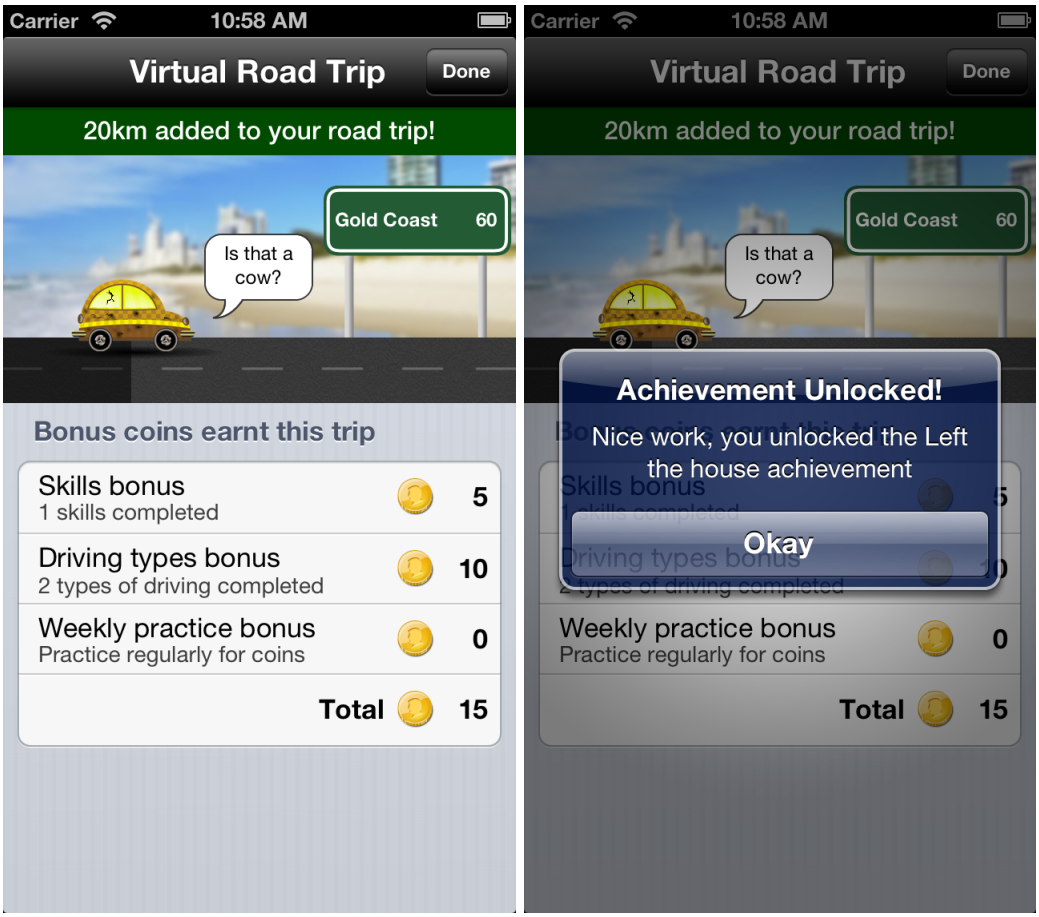

Figure 7.17 – Post-practice road trip summary and achievement unlock views

ROAD TRIP OVERVIEW

The road trip overview page showed how close users were to reaching the next city on the road trip. It also provided an overview of total kilometers travelled, friends added, achievements unlocked and coins available.

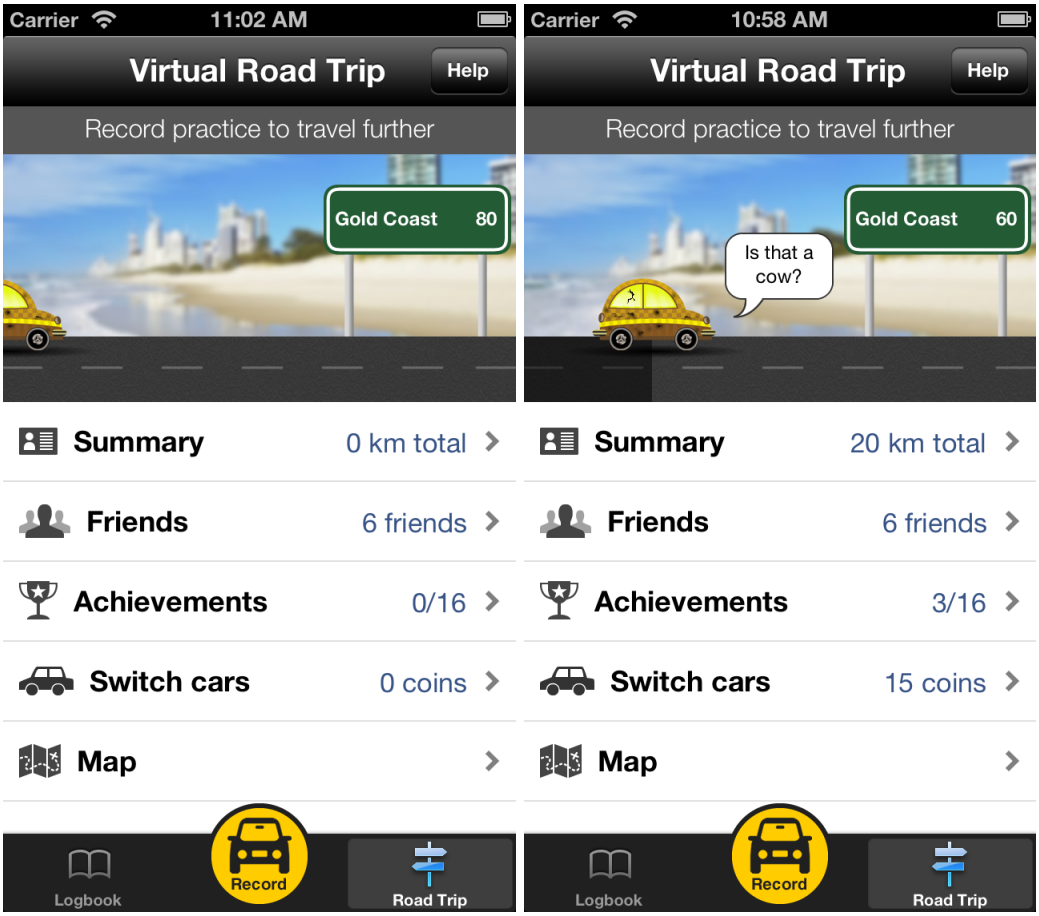

Figure 7.18 – Road trip overview before and after adding practice

ROAD TRIP FRIENDS AND ACHIEVEMENT VIEWS

Players could add friends and see their current location on the road trip as well as the car their friends were currently using. For the field experiment false data was provided to the user in this section, as they did not have any friends using the application with them. To achieve this, a list of false names was added to their friends list and the researcher told the participant that these were other participants using the application. It was decided to keep the participant towards the top of the list in either

first, second or third place, and this was done programmatically depending on their current road trip total.

A list of achievements was also available which learner drivers could unlock for reaching important milestones and completing specific driving tasks. These were added to support and indicate useful activities to the player that may help them on their road trip. They also suggested activities that would help players unlock more coins that could be used on the road trip, as opposed to simply being there as reward-based elements.

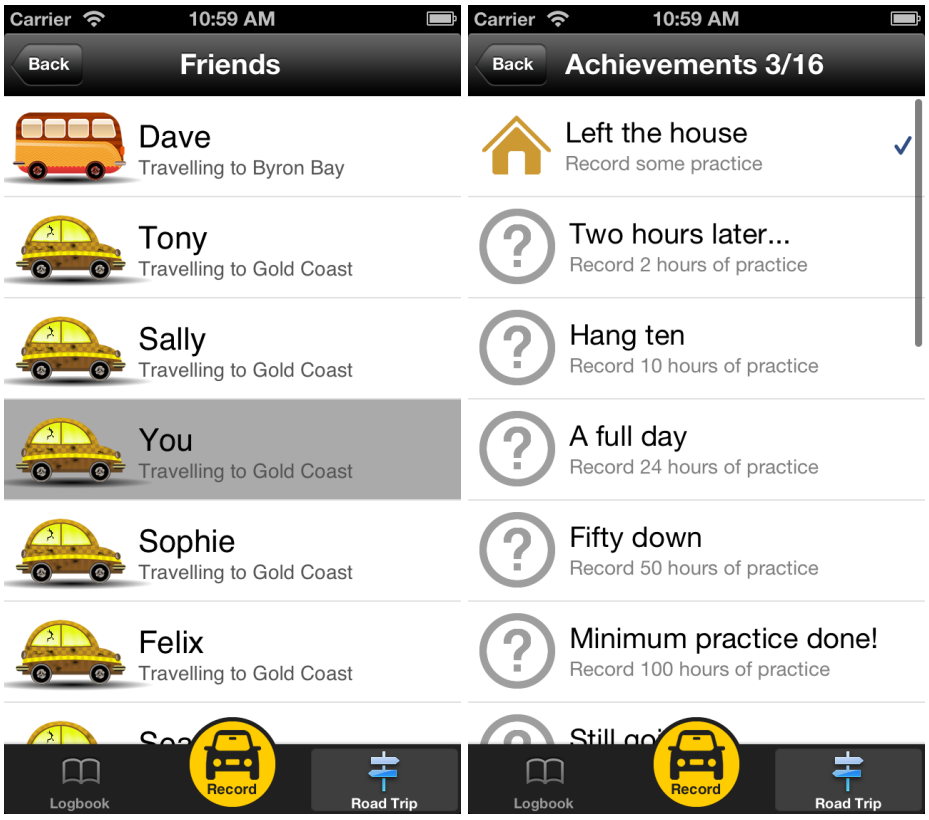

Figure 7.19 – Friends and Achievements View

Players received coins for undertaking diverse and regular practice; these coins could be used to purchase new cars that would make the road trip easier to complete. Players were encouraged to upgrade their car as soon as possible as their first car was an old one, which broke down on the virtual road trip regularly.

A map view provided an overview of the paths learner drivers could take on their virtual road trip around Australia.

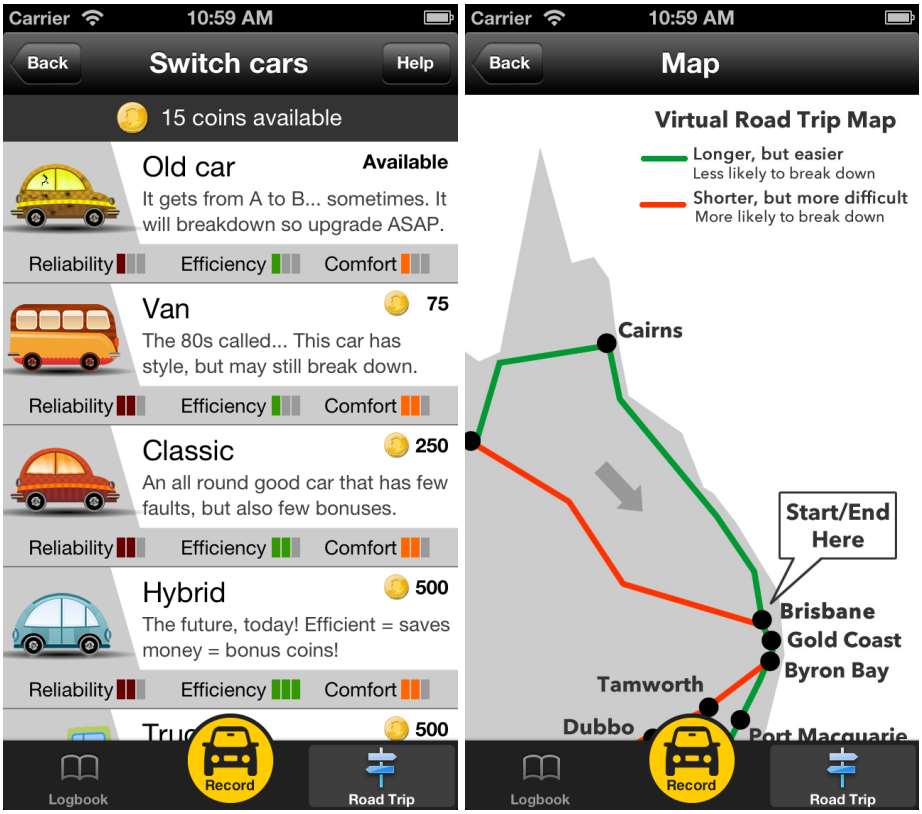

Figure 7.20 – Car and Map Views

Help screens were also provided on each screen in order to provide contextual help for learner drivers who did not understand a particular part of the virtual road trip.

7.5 CHAPTER SUMMARY

This chapter presented an overview of the design of a gamified mobile application for learner drivers using the updated gamification design framework proposed in chapter six. The target player was established and a gamification design document was created to aid in the design of an effective gamification experience. An iterative design process was used along with the framework, and a usability and playability study was run in order to improve the gamification design. The finalised prototype will be evaluated in the next chapter using a field study.

8. EVALUATING THE LEARNER LOGBOOK GAMIFICATION DESIGN

To investigate the usefulness of the updated framework, a field study was undertaken to evaluate the resulting gamification design. A total of 25 learner drivers were recruited to try two different versions of the logbook application, a gamified version and a non-gamified version. Participants used one version of the application for two weeks and provided feedback on their experience. They then tried the other version for an additional two weeks, again providing feedback on their experience. This chapter presents the findings of the study and discusses the effectiveness of the design and framework.

8.1 FIELD STUDY OVERVIEW

The aim of the field study was to evaluate the effect the gamification experience had on user experience, perceived motivation, and behaviour change. The study also looked at investigating the reception of the added gamification. Four hypotheses were formed:

1. We predict that participants will have a more positive user experience when using the gamified version compared to using the non-gamified version.
2. We predict that participants will feel more motivated when using the gamified version compared to using the non-gamified version.
3. We predict that the gamified application will encourage behaviour change compared to the non-gamified application.

In addition to these three hypotheses, three research questions were also investigated:

1. Is the addition of game elements well received by the participants?

2. Does the addition of game elements negatively affect the ease of use of the gamified application compared to the non-gamified application?
3. Does the addition of game elements lead to any unintended consequences compared to the non-gamified application?

To measure the constructs, quantitative and qualitative data were gathered from application usage logs, questionnaire data, and interview data.

8.2 FIELD EXPERIMENT RESULTS

An analysis was undertaken of the quantitative data using SPSS, and on the qualitative data using NVivo, with the following results.

8.2.1 PARTICIPANT DEMOGRAPHICS

Twenty-five participants undertook the study (male = 11, 44%; female = 14, 56%). Their ages ranged from 16 to 28 years old, with an average age of 19.44 years (SD = 3.43).

LEARNER LICENCE LENGTH

All participants held a Queensland Learners Licence during the period of the study. On average, the participants had held their licences for 22 months (SD = 19.331).

PRACTICE UNDERTAKEN

Two participants were unable to provide an overview of the previous practice they had undertaken because they did not use a logbook (they were over 25 and recording practice in a logbook is not required for those over 25). For those who did (n = 23) the amount of practice undertaken varied greatly from participant to participant. Participants had undertaken on average 19.51 hours of daytime driving (SD = 22.190),

6.17 hours of night driving (SD = 11.516), and 9.82 hours of accredited driver training (SD = 10.838)[2].

Participants had undertaken on average 8.48 practice sessions in the last month (SD = 11.630), an average of about two a week. Interview responses supported this weekly practice with the majority of participants sat they practiced one or more times a week. For those who did not practise very often, three themes emerged to explain this: because of an injury, sickness, or holiday; because they do not enjoy driving; or because they do not really need their licence.

Practice was split, with some participants going out just to practise driving and others integrating it into their own or their supervisor's daily tasks and activities. Some participants commented that they would go out to practice without any detailed plan of what they wanted to practice. Those integrating practice into activities and tasks listed going shopping, going to a sport event or the gym, or going to work. The variety of practice amongst participants varied greatly. Some went out of their way to do as much different practice as possible, while others noted that they do the same practice over and over again, generally because the practice will be tied to a specific activity such as going to work.

Interview responses revealed that participants were primarily supervised by a parent or someone else in their family. Some participants used accredited driver trainers, and one participant reported looking for supervisors online via the *Gumtree* website (http://gumtree.com.au), as their parents were living in another country.

[2] Note: as an incentive, any time spent learning with an accredited driver trainer is multiplied by three, up to a maximum of 30 hours (1800 minutes) in Queensland.

LEARNING TO DRIVE EXPERIENCE

Of the 25 participants, 18 reported in the questionnaire that they found learning to drive to be an enjoyable experience overall. Short answer responses that asked participants why they found it enjoyable were tagged with four themes: freedom and independence (11 responses), the experience of driving (nine responses), good support from the instructor/supervisor (four responses), and mastery of a new skill (three responses). It is worthwhile noting that all participants who had their licence for 15 months or less responded that they enjoyed the learning experience (n = 12). This was supported by interview responses as well, with a number of participants who had just started to learn to drive reporting that they enjoyed the experience.

The remaining eight participants reported that they did not find learning to drive an enjoyable experience. Short answer responses that asked participants why they did not find it enjoyable were tagged with three themes: learning to drive is tedious (four responses), learning to drive can be stressful (three responses), and the logbook can be difficult to use (one response). Interview responses also found that some of the participants found learning to drive to be a boring activity.

REACTIONS TO THE MANDATORY 100 HOURS

Participants were asked in the interview what they thought of having to undertake 100 hours of mandatory supervised practice. Participants generally reported that they thought it was a suitable amount of time to build confidence and experience. One participant said, *"I feel that's a reasonable thing to do (…) so you have the right experience and stuff."* Some participants over 25 didn't need to complete 100 hours of supervised practice, but wanted to do so anyway to feel more comfortable and confident: *"I don't need these 100 hours but I want to do the 100 hours before I go for my drivers licence test to make sure that I'm comfortable. (…) They obviously need them as they thought 100 hours sufficient training time, so that's what I'm going to do."*

Some participants reported that the required amount of practice was too long, but still a good thing to do. This was because it could be diffi-

cult to for some participants to find opportunities to drive: "*I don't have as many opportunities to drive as some of my friends (…) it's hard for me to get my hours up*." For some participants it meant that if others were doing it then *"it just means that there will be better drivers on the road*". Some participants thought that they could become a more confident driver in a smaller amount of time. One also said that that the driving tests instead should be made harder instead of having mandatory practice. Supervisors may also find the mandatory driving practice a long time, with one participant saying that their supervisor *"just started writing things down on pieces of paper so I could get my hours up because she's starting to get frustrated"*.

USEFULNESS OF THE PHYSICAL LOGBOOK

Of the 25 participants, 16 reported that they found the logbook useful for recording the 100 hours. Positive short-answer questionnaire responses reported that, to them, the logbook was useful for keeping track of practice. Although participants found the logbook useful, 14 of the 25 participants also described negative aspects of the logbook. Coded responses included the logbook being a *tedious process to fill out* (eleven responses), being *easily forgotten* when going out to practice (three responses), being *easy to damage* (two responses), participants may *forget to enter information* (two responses), *cumbersome* (one response), and having the ability *easily enter false data* (one response).

Interview responses supported these findings, with some participants discussing the usefulness of being able to record their practice using the book. Others discussed its usefulness, but also raised downsides to the logbook, primarily revolving around the tedium of filling it out. Negative themes that arose from the interviews reported that the logbook could be *annoying to fill out, lost or forgotten on trips, is falling out, can be annoying to carry around, is falling apart*. The most common sub-theme discussed in relation to filling out the logbook was a *repetitive and tedious process*, with twelve participants discussing this aspect in detail. Other negative aspects raised included that the logbook *takes time to fill out*, *doesn't have enough space for details*, that sometimes participants may *forget to fill out the start odometer*, and that it *can be messy to fill out*. One

participant provided a succinct summary of their overall logbook experience as "*such a pain in the ass.*"

There were 10 participants who noted that they enter practice details into their logbook every time they go for a drive. However, a number of participants commented that they would fill out the logbook *at a later time*, often at home. Five participants noted that they filled out practice sessions from memory, while four participants described that they used their phone to record necessary details and then filled out their logbook later. Two participants said that they leave the logbook at home and use paper to record their practice, while two participants said that they do not fill out the logbook for short drives or if they are in a rush. Four participants commented that it would be easier for them if there were a smartphone application available that could log practice for them.

SMARTPHONE AND VIDEOGAME USAGE

All 25 participants reported that they used a smartphone on a daily basis. Participants reported that they had been using a smart phone on average for the last 2.16 years (SD = 1.284). Participants on average reported that they spent on average 4.85 hours a day using their smartphone (SD = 4.691).

Videogame usage varied between participants. Two reported that they had not played video games before. The remainder had been playing video games for an average of 8.12 years (SD = 8.12). On average participants play 8.10 hours of games (SD = 11.447). But these results varied greatly between participants: five reported that they do not play any videogames during the week, 11 reported between 1 to 5 hours a week (on average less than 1 hour a day), two participants reported 10 to 14 hours a week (on average over 1 to 2 hours a day), three participants reported 19 to 28 hours a week (on average over 2+ hours a day, and one reported he plays 50 hours a week.

Participants also reported that they enjoyed playing a wide range of different videogame genres, the most popular being action, followed by puzzle, and the least popular being the sports genre.

Videogame Genre	Frequency
Action (e.g., Super Mario, Street Fighter, Call of Duty)	18
Puzzle (e.g., Tetris)	16
Arcade (e.g., Angry Birds, Pac Man)	15
Action-Adventure (e.g., The Legend of Zelda series, Grand Theft Auto, Resident Evil)	14
Simulation (e.g., SimCity, The Sims)	11
Role-playing Games (e.g., Final Fantasy, Diablo, Elder Scrolls, World of Warcraft)	10
Strategy (e.g., Civilization, Warcraft series, Age of Empires series, StarCraft)	7
Party (e.g., Mario Party, Rock Band, Sing Star)	5
Sports (e.g., Fifa series, Championship Manager)	1

Table 8.1 - Video game genres enjoyed by participants

8.2.2 USER EXPERIENCE RESULTS

The following results compare user experience in both applications. Individual aspects of user experience are investigated, including concentration, enjoyment, perceived control, challenge, perceived ease of use, perceived usefulness, engagement and preference.

User Experience Measures	Gamified Version (n=25)	Non-gamified version (n=25)	*z*	*p*
Concentration	5.75	5.50	-0.162	.871
Enjoyment	6.00	5.00	4.037	< .0001
Perceived Control	5.25	5.25	-0.948	.343
Challenge	5.00	4.67	-0.657	.511
Perceived Ease of Use	6.75	7.00	-1.021	.307
Perceived Usefulness	6.00	5.67	-3.56	.722

Table 8.2 – Median User Experience and Usefulness Scores for Gamified and Non-Gamified Versions of the Logbook Application

Measure	Gamified Version	Neither version	Non-gamified version	$\chi^2(2)$	p
More Enjoyable	22	1	2	33.68	< .001
Preference	18	1	6	18.32	< .005

Table 8.3 – Chi-Square results for enjoyable and preference measures Gamified and Non-Gamified Versions of the Logbook Application

CONCENTRATION

Of the 25 participants, when using the gamified version of the application 12 participants reported an increase in concentration, six participants reported no difference, and seven participants reported a decrease in concentration. A Wilcoxon signed-rank test determined that there was no significant median increase in reported concentration when using the gamified version compared to the non-gamified version.

ENJOYMENT

Of the 25 participants, when using the gamified version of the application 21 participants reported an increase in enjoyment, three participants reported no difference, and one participant reported a decrease in perceived control. A Wilcoxon signed-rank test determined that there was a significant median increase in reported enjoyment when using the gamified version compared to the non-gamified version.

After trying both applications, participants were asked in the questionnaire to choose which of the applications they found most enjoyable to use. They could choose the non-gamified version, game version, or neither version. The majority of participants chose the gamified version (N = 22). A chi-square test of goodness-of-fit was performed to determine whether the three options were equally preferred. Preference for the three options was not equally distributed in the population. These results suggest that the gamified logbook was significantly more enjoyable to use.

PERCEIVED CONTROL

Of the 25 participants, when using the gamified version of the application nine participants reported an increase in perceived control, three participants reported no difference and 13 participants reported a decrease in perceived control. A Wilcoxon signed-rank test determined that there was no significant median increase in reported perceived control when using the gamified version compared to the non-gamified version.

CHALLENGE

Of the 25 participants, when using the gamified version of the application eight participants reported an increase in challenge, seven participants reported no difference and 10 participants reported a decrease in challenge. A Wilcoxon signed-rank test determined that there was no significant median increase in reported challenge when using the gamified version compared to the non-gamified version.

PERCEIVED EASE OF USE

Of the 25 participants, when using the gamified version of the application three participants reported an increase in perceived ease of use, 12 participants reported no difference and 10 participants reported a decrease in perceived ease of use. A Wilcoxon signed-rank test determined that there was no significant median increase in reported perceived ease of use when using the gamified version compared to the non-gamified version.

PERCEIVED USEFULNESS

Of the 25 participants, when using the gamified version of the application 10 participants reported an increase in perceived usefulness, five participants reported no difference and 10 participants reported a decrease in perceived usefulness. A Wilcoxon signed-rank test determined that there was no significant median increase in reported perceived usefulness when using the gamified version compared to the non-

gamified version. It is worth noting that both mean results for perceived usefulness were high scores, 6.56 (SD = 0.953) for the non-gamified version, and 6.51 (SD = 1.264) for the gamified version.

NON-GAMIFIED VERSION USER EXPERIENCE INTERVIEW FEEDBACK

Feedback from participant interviews for the non-gamified version of the application was generally positive. A number of sub-themes arose which revolved around the *efficiency*, *convenience* and *ease of use* of the application. The efficiency of using the application to record practice was a reoccurring theme that arose from interview discussions: "*You just have to press record and it records everything, so it's a lot easier than writing everything down and stressing about not writing things down*", and "*it was a lot easier to put in the hours and the time, the odometer.* Another theme that arose was that it was convenient because it was a mobile application: "*It was good, it was convenient, it was easy to record driving when I didn't have my logbook on me*" and "*I found it really convenient and really easy to use. I really liked it I guess*." Participants also reported they liked the interface and layout: "*Personally I think it was really good. I liked the really simple user interface*" and "*it's really easy to start because I just have to open it and tap the odometer […] it's just really nice, the layout is really good as well.*"

GAMIFIED VERSION USER EXPERIENCE INTERVIEW FEEDBACK

The feedback for the gamified logbook application was similar to the non-gamified version in terms of usability: "*It was easy to use, really straightforward",* and "*It was just as good as the other one. It was helpful and it made it easier because you just click record and have the odometer, and it was easy to use."* However, in addition to usability themes that included *useful, ease of use,* and *convenient,* a number of participants also noted that this version of the application was also *motivating* and *fun to use*: "*It was quite similar to the first one, but I also found the road trip feature was just kind of like a fun little thing to motivate you"; "I think it's a real asset to the application because it's something that's fun and would motivate people to want to drive",* and *"I did want to practise because I wanted to play the game"*. Two participants also noted that the logbook felt more like a game than a logbook: *"I don't feel like I'm actually putting my hours into*

my logbook, I feel like I'm playing a game" and "*when you have your logbook it's such a pain to fill in all the hours and stuff, but this sort of just made it fun and like a game*."

COMPARED TO THE PHYSICAL LOGBOOK

Although not explicitly asked, some participants compared the non-gamified version to the physical logbook. Of the 11 participants that discussed this, some noted that the mobile application was better than the physical logbook because it was more convenient to take with them: "*It was so much easier to use than the logbook because […] my phone goes with me everywhere and my logbook doesn't"* and *"It's better than carrying the logbook around, that's for sure."* The mobile version was also reported as more efficient than the physical logbook: "*you don't have to add in all the supervisor information over and over again, and the car information*" and *"it was a lot quicker than the logbook, you just open it up, put in the odometer and then you just go."*

Similar themes arose with feedback on the gamified logbook as well, with 14 participants discussing how this version was better than the physical logbook. Participants reported it was more convenient: "*my phone is always on me and my book isn't and because I have a lot of family and cars and it's hard to keep carrying my logbook with me everywhere";* more efficient: "*this is great, it's so much easier than having to write out everything manually every single time*", and also more fun: "*this sort of just made it fun*."

APPLICATION PREFERENCE

After trying both applications, participants were asked in the questionnaire to choose which of the applications they preferred to use. They could choose the non-gamified version, game version, or neither version. A total of 18 participants chose the gamified version, six participants chose the non-gamified version of the application, and one chose neither version. A chi-square goodness-of-fit test was performed to determine whether the three options were equally preferred. Preference for the three options was not equally distributed in the population.

These results suggest that the gamified logbook was significantly preferred over the non-gamified logbook.

GAMIFIED LOGBOOK PREFERENCE

Interview results supported the quantitative preference results, with the majority of participants reporting that they preferred the gamified version compared to the non-gamified version. Three sub-themes arose to explain this: *it felt like a game, it was more motivating,* and *it provided better feedback and goals.* The most common response was that participants preferred the gamified version because it felt like a game: "*definitely I preferred this one (gamified version). I don't feel like I'm actually putting my hours into my logbook, I feel like I'm playing a game*", "*personally I liked the second one better (gamified version) because it had everything that the first one did, but also the fun little game as well*" and "*(The non-gamified version) was still a really helpful tool if you're doing your driving, but the game elements just made it a bit more fun.*" A number of participants elaborated further, discussing specific game elements that drew them in and engaged them, such as competition, collecting coins, upgrading their car, and collecting achievements.

Six participants discussed that they found the gamified version more motivating than the non-gamified version: "*It's more motivating to try and get around Australia*", "*I found it like a challenge to see how many kilometers I can go*", and "*It also motivated me more, I enjoyed it a lot more because it's more fun in my opinion, like a game.*" Six participants noted that the road trip version provided clear goals and feedback. "*I liked the way it summarised the kilometers as a distance, it was a bit more clear what it was, as opposed to just numbers*", "*I wanted to keep looking at the road trip and see how I was going*", and "*the game one was better because it felt like you were playing a game and it had things to achieve.*"

NON-GAMIFIED LOGBOOK PREFERENCE

Five of the participants commented that they preferred the non-gamified version of the application primarily because it was simpler, or more straightforward. "*The other one (gamified version) was more complex, and had more elements to it. I prefer something that's just simple, that is just a*

logbook, nothing really else", "(The non-gamified version) was a lot easier to use because you don't have to check the game version and see what other people are doing" and *"(The non-gamified version) just seemed cleaner and more practical."* One participant was underwhelmed by the gamified version, explaining that when he heard the word 'game' he expected a full-fledged game being available in the application: *"I thought there was an actual proper game there that I could play a little bit."*

8.2.3 MOTIVATION AND BEHAVIOUR CHANGE RESULTS

The following results compare both applications in terms of motivation and behaviour change. The measures include total practice, practice diversity and practice regularity. Application usage data was successfully captured from 21 participants for both the non-gamified and gamified applications. Questionnaire and interview data was available from all 25 participants.

Motivation Measures	**Gamified Version (n=25)**	**Non-gamified version (n=25)**	*z*	*p*
Perceived Motivation Scale	6.5	5.5	2.804	.005
Behaviour change measures	**Gamified Version (n=21)**	**Non-gamified version (n=21)**	*z*	*p*
Total number of sessions undertaken	2	3	1.402	.161
Total time spent practicing	117	91	1.502	.133
Total number of skills practiced	1	0	2.190	.029
Number of different contexts practiced	2	3	1.511	.131

Table 8.4 – Median Motivation and Behaviour Change Scores

Measure	Gamified Version	Neither version	Non-gamified version	$\chi^2(2)$	p
More Motivating	20	2	3	24.56	< .0005

Table 8.5 – Chi-Square results for enjoyable and preference measures

PERCEIVED MOTIVATION

The gamified version of the application elicited a statistically significant median increase in reported motivation, with 16 participants reporting a positive difference in motivation in response to the gamified version, six participants reporting no difference and three participants reporting a negative difference. After trying both applications, participants were asked which one they found most motivating to use: the non-gamified version, gamified version, or neither version. The majority of participants chose the game version (N = 20). A chi-square goodness-of-fit test was performed to determine whether the three options were equally preferred. Preference for the three options was not equally distributed in the population. Therefore, results suggest that significantly more participants found the gamified version more motivating to use.

TOTAL PRACTICE

Of the 21 sets of captured data from participants, when using the gamified version of the application nine participants undertook more practice sessions, four participants undertook the same number and eight participants undertook less practice sessions. A Wilcoxon signed-rank test determined that there was no significant median increase in number of practice sessions when using the gamified version compared to the non-gamified version.

Of the 21 sets of captured data from participants, when using the gamified version of the application 11 participants practiced a longer amount of time, three participants practiced the same amount, and seven participants practiced a shorter amount. A Wilcoxon signed-rank test determined that there was no significant median increase in total time spent practicing when using the gamified version compared to the non-gamified version.

A separate Likert-type question in the questionnaire asked participants to report on whether the game elements motivated them to undertake more practice. The median response was 'agree' and the mode was 'strongly agree' indicating that generally participants subjectively felt that the game elements had an affect on their motivation to drive. However, other external elements may have interfered with the amount of practice undertaken.

Participants were asked in the interview how each version of the application affected their motivation to practice driving. Responses indicated that the non-gamified version had little to no effect on motivating the participant to drive more. Some said that the convenience of the application meant they recorded more practice sessions when they otherwise would not have: *"I was probably driving more because I really didn't have to think about it because I always had my phone with me. It was easy for mum and I to be out and say let's do it now."* Two participants noted that they drove more than usual, but it was not because of the application, rather it was due to one of them having more time to practice and the other needing to obtain their licence before their learner period ran out.

Compared to the non-gamified version, more participants reported that the gamified version motivated them to practice: *"I did want to practice because I wanted to play the game", "I really wanted to do extra driving just because I wanted to get around Australia and get coins and stuff. It actually really motivated me"* and *"Right now I'm at the point where I'm bored of putting my logs into my book and I just really don't want to anymore. But the game would actually motivate me to actually put the entries in."* Various influential game elements were discussed by participants, including the competitive elements: *"it definitely motivated me to want to practice more because there was that competition factor",* as well as wanting to upgrade their virtual car: *"The fact that my car kept breaking down encouraged me to do more to get more coins to buy a new car"*, and by having achievements: *"I went out of my way to do that right hand turn across traffic just so I could get the achievement."*

PRACTICE DIVERSITY

Participants could record any driving skills completed during each practice session (e.g., U-turn, Reverse Parallel Park, Hill Start). Of the 21 sets of captured data from participants, when using the gamified version of the application 12 participants recorded more skills, three recorded the same number and six recorded less. A Wilcoxon signed-rank test determined that there was a significant median increase in the total number of recorded skills when using the gamified version compared to the non-gamified version.

Participants could also record any specific driving contexts that they drove in during each practice session (e.g., Heavy Traffic, Unsealed Road, School Zone). Of the 21 sets of captured data from participants, when using the gamified version of the application eight participants recorded more contexts, three recorded the same number and six recorded less. A Wilcoxon signed-rank test determined that there was no significant median increase in the total number of recorded contexts when using the gamified version compared to the non-gamified version.

A Likert-type question in the questionnaire asked participants to report on whether the game elements motivated them to undertake more diverse practice. The median response was 'agree' and the mode was 'strongly agree' indicating that generally participants reported that they perceived the game elements had an affect on their driving motivation.

After using the regular logbook a few participants reported in the interview that they undertook more diverse practice due to the added checklist functionality in the application: *"At the end where you press the save trip, it has all those lists of things that you did and I found that I was trying to tick off more as the weeks went along, and make sure that I tried to cover some of those things"*, *"Having them just as a list there to tick off, that was great. And that actually motivated me as well in both the apps"*, and *"it was so helpful actually because I hadn't actually thought about what I needed to work on until I saw that and it actually gave me all the options and then the next time I went out for a drive I was actually thinking about it."*

In addition to this, some participants reported in the interview that the game elements in the gamified version encouraged them to undertake more diverse practice: *"I would try and integrate some of the skills so I could get coins. It was kind of fun doing the road trip thing, it was kind of like a challenge, you want to get to the next city and then you realise that the car breaks down and you've got to get a better car"*, *"Different types of practice to get the coins. Rather than just parking in front of cars, I did actually reverse parallel park so I could tick it off the list which, I mean, is a good thing. If practising manoeuvres can be made fun, then why not?"* and *"The way that if you do special stuff, like reverse parallel parking, it gives you more points so it sort of rewards you which is good. Because it really encourages you to do more."*

EXTERNAL FACTORS

A number of external factors were reported that might have affected the amount of practice undertaken by participants during the study. After using each version of the application, participants were asked if there was anything that may have affected the amount of practice they undertook. Responses were grouped into the following:

1. Supervisor availability and cost of learning
2. Learner driver commitments (e.g., school, university, work, exams, holidays)
3. External events outside the control of the learner driver (e.g.., sickness, or crashing the car)

If a supervisor's parents were busy it made it difficult to schedule in practice sessions with them. Learners could be supervised and taught by accredited driver trainers, however, driver trainers can be expensive and the cost of fuel and running a car can create extra expenses as well that may affect practice undertaken: *"Parents have restricted available time so it's difficult to get proper supervised practice outside of paid lessons (which are expensive!)"*, *"Cost of fuel"*, *"I didn't have any time to practice due to no one being available to supervise/instruct me"*, and *"Parents went on holiday so less time to be able to drive"*.

A number of other commitments affected participants' availability to practice, such as school, university, work, extra curricular activities, and caring for children: *"Work affected the amount of practice I did"*, *"Starting University and work were the main things affecting practice"*, *"Looking after baby, show rehearsals"*, and *"This is the busiest term of the year and being in grade 12, everything counts. So I did not manage to do many driving lessons."* These issues can be considered normal external factors that will influence the ability to learn to drive.

8.2.4 GAMIFICATION EXPERIENCE RESULTS

A number of short questionnaire answers and interview questions were used to evaluate aspects of the gamification experience. The qualitative results were transcribed and analysed for related themes. These themes are discussed in detail below, highlighted using relevant quotes from participants.

ACTIVITY GOALS VS. GAME GOALS

Participants generally agreed that the game elements aligned well to the goals of learning to drive. Only one participant related a feeling of confusion when their car broke down, as they were unsure why it happened: *"One time it said I broke down and I was like 'No!' (…) Why would it do that?"* When asked why they thought it broke down, they tried to explain it: *"Is it because… was it because one of the times I didn't add any features to it? Yeah, I think that's why."* In the game, however, breakdowns are random events, affected by the player's choice of car.

The remaining feedback about goal alignment was positive, with participants reporting that the game elements linked to the practice sessions well: *"I think they link pretty well, when I ticked off skills done and stuff (…) I got more achievements and stuff and I got more coins"*, *"It made sense. I liked how it's got that extra element where you write what you achieve and what to work on next time, which is something you don't get out of the logbook which is good"* and *"It was just good to see how many kilometers you'd actually done and see how far you could have actually driven if you did those kilometers in real life."*

THE ROAD TRIP PROVIDES FEEDBACK

It was noted that participants thought the road trip feature provided feedback that was missing from both the physical logbook and non-gamified version of the logbook application: *"I like how it shows you that (distance travelled around Australia), because a lot of the time if you're just driving around your neighbourhood you don't really realise how far it actually is"*, *"I like how it does that (…) it shows you how far you've travelled in real life",* and *"I liked how you could see it sort of going around the map (…) you can see the progress you were doing, rather than just numbers in a logbook."*

LONG-TERM ENGAGEMENT

Three themes emerged when participants were asked if they would get bored of the game elements over time: the game elements would continue to engage over time, it is difficult to know if they would continue to engage over time, and over time the game elements could get boring.

A number of participants reported that they felt the game elements would continue to engage them while they are learning to drive: *"At the moment we've only got logbooks anyway which isn't exciting at all, but this is a little bit more fun, so I don't think I'd get sick of it"*, *"I don't think I'd get bored of them before I finish my 100 hours"*, and *"Because you go around Australia so that's a long distance, and that will probably sum up your 100 hours about (…). I really don't think I'd have any issues with getting bored, there's always something to do."*

A larger number of participants reported that they were unsure if the game elements would continue to engage them over time: *"I think the novelty aspect of it is interesting but afterwards I wouldn't really care about it, but I think coming back to it, it was getting interesting"*, *"As it happens with most games, there's a certain amount of time which you play it. This one's a little bit different, it's not just a game where you can keep playing it quickly and get bored of it"*, and *"I guess you could get bored of it, but it's not like you're continuously playing it. It's only adding in data (…) it would still be motivating, I'm not sure how long it would be motivating to do the whole 100 hours."*

A few participants also reported that the game elements could get boring over time: "*Once you unlock the last car there wouldn't be much use to the game besides just getting the distance*", and "*There'd be sort of a point you'd plateau with exciting achievements popping up and stuff like that I'd guess, but I'd probably still glance at it.*" Two participants commented that they liked having the game elements compared to having an application without them. Two other participants also noted that if their friends were using the application then this would keep them engaged as well: "*If everyone's competing against each other then it definitely wouldn't get boring.*"

A number of participants commented that if other game elements were added to the application this would keep them more engaged with it: "*I think it would be really cool if there were updates where you could get even better cars and stuff like that because eventually you'd get to the top of the game*", "*Maybe if you had like side missions? And make it more interactive. For example if you got to a check point and you had to parallel parking or something*", and "*If there was more variety of challenges or optional side challenges that you could do or something then it might make it more encourageable to play it over time*."

CHEATING

Two participants admitted to cheating during the study, one participant cheated to progress further in the gamified version, and the other cheated in the non-gamified version simply to see if he could. A further six participants admitted in the questionnaire that they might consider cheating if using it for longer.

When asked in the interview if they would cheat, the majority responded that they would not. When asked why, participants responded that it could ruin the game experience; "*It sort of ruins how you play the game*", particular if playing with other people; "*No, I don't think I'd do it in the app, because if you're competing with other people and you're doing fake numbers it would kind of not mean anything if your friends were on it*" and "*I like beating people fair and square.*" Two participants did not know that they could cheat; "*How would you cheat? I don't even know how you'd cheat?*" Some participants made the link that if they cheated in the game it

would mean that they would also be adding fake data to their logbook, and they would not do this: "*if I cheated it wouldn't be what I've actually done, it's like faking hours in a logbook and I don't really agree with that.*" Some did note that they would not cheat if the application was an official application: "*It depends, if the road trip part was official? Then no*" and "*If it was like just a game then maybe but because it's about me actually driving, related to the real world, then I probably wouldn't.*" and "*No! They would probably catch me out.*"

Although the majority of participants said they would not cheat, some participants did not trust other users not to cheat. But this view generally grew from the belief that some other Learner Drivers currently fake their practice anyway to get their licence earlier, not because of game elements: "*I guess people would cheat in real life for hours, but in the end it's a game*", and "*I guess some people may cheat with their logbook hours to get their P (Provisional) licence earlier, but I don't really see a point.*"

DISTRACTIONS

Participants were asked in the interview if the added game elements distracted them from practising at all. The majority of participants responded that they did not find the game elements distracting. This included while driving: *"the main aspect of the application is pressing start and stop at the end, so looking at the game elements was just where I'd gotten, and how fast I could look through it. It wasn't in the way during the actual driving time or anything like that", "it didn't affect my driving, it was just after the fact that I wanted to see how far I'd gone and if I earnt any coins"*, and *"If you're driving, you don't pay attention to that. You're just paying full attention to what you're doing - which is driving. And you only see that after you stop driving. So it wouldn't be distracting at all."* Participants did not find them distracting while using the application: "*It takes a little bit more time to pay attention to it, but it's worth it because you're motivated in the first place, if that makes sense*", "*It just worked same for me. Apart from having the extra bits to play around with to see how far I could go on the map*", and *"Not at all. It's just that separate menu in the bottom right, I think it's a really good idea."*

A few participants noted that the game elements might be distracting before they began their practice session: *"Maybe when I was getting ready for the trip I was looking at the achievements and stuff instead of actually preparing to driving (…) but it's fun!"* Another participant commented that the game elements might be distracting while driving: *"I do like games, but at the same time I do like having my full attention on driving, because it's driving and if you're like thinking 'Oh what I'm doing right now could get me an achievement' then yeah it could also get you killed."*

One participant did note that unlocking many achievements at once after a drive was completed could be distracting, as the application displayed a pop up alert for each one: *"Sometimes, I don't want to look at my achievements right now, I just want to put my phone in my bag and drive or whatever."*

One participant thought the application would be simpler without the game elements: *"It's like, it keeps it simpler (without the game). I play games because I'm in the mood to play games but if I'm adding another game as well as driving it sometimes gets me distracted while I'm driving."* Two other participants felt that the game elements may be better if they were provided as an optional extra to the main logbook functionality: *"People (…) who just want to use the app to record their hours might not use it as much. But people like me, we could choose to use it if we wanted to"*, and *"I would like to have the option to do it (the game) but maybe I wouldn't personally use it*".

DANGERS

Participants were asked in the interview if they believed the game elements did, or could, lead to any dangers. The majority of participants responded that they did not believe the game elements would: *"No. I don't see how there could be dangers. Unless you're driving too long, or using the app whilst you're driving, I don't see there's anything from using it"*, and *"No (…) the game itself doesn't require you to do anything other than drive."*

Some commented that the dangers would be minimal because interaction with the game elements occurred after practising was over: *"No I don't think there's any, because you don't have to be on the game while driv-*

ing, so that's not a problem. I think the game's a perfectly safe addition", *"when you've turned on the app, once you say start, it will tell you don't touch your phone and nothing will happen until you turn it off. So it's not invasive to your driving"* and *"Not really because you do that (interact with the game elements) after the drive, in theory at least. So I don't think it's really a problem, it's safe to drive with.*" However, one participant did note that they may be thinking about the game while they drive: "*I do like games, but at the same time I do like having my full attention on driving, because it's driving and if you're like thinking 'Oh what I'm doing right now could get me an achievement' then yeah it could also get you killed."*

One participant commented that they thought some other players "*might try to race ahead in skills when they're not ready or at the level of driving they should be".* But other participants believed that the game elements would not motivate them to do anything dangerous: *"I didn't, because I'm not that skillful at stuff, so I didn't want to practice parallel parking and hit stuff."* Another participant noted that the game elements did not encourage dangerous activities: *"it's not like any of the achievements are like 'You drove super fast' or something. It just seems to be pretty similar to the logbook, and that doesn't cause much in terms of danger and the game is mostly just logging the kinds of things that you'd kind of naturally do anyway."*

ENJOYMENT

A 7-point Likert-type question in the questionnaire asked participants to report whether they found the game elements to be enjoyable or not. The median response was 'agree' and the mode was 'strongly agree' indicating that generally participants reported that they were enjoyable. Qualitative feedback supported the questionnaire findings, with the majority of participants reporting that they liked having the game elements as part of the application: *"I thought that was the best, most appealing (part) of it. (…) It turns it into something goal oriented, and a game"*, *"I thought it (the game) was a good idea. I really liked it"*, and *"The app itself worked great, didn't have any issues with it. I especially liked the game section of it (…) the fact that it's a game made it fun"*

When participants were asked if there was a particular part of the gamified version they liked the best, a number of elements were noted. Some participants said they liked the competitive aspect encouraged by some of the game elements: *"I would just want to achieve them all (the achievements), like to see what happens when you get it and try and get it before anyone else. I'm so competitive, I love playing games and beating people"*, *"for anyone who's competitive like me, that's kind of a good thing to have"*, and *"it definitely motivated me to want to practice more because there was that competition factor."* Other elements noted by participants included achievements, upgrading the car, getting coins, and undertaking the road trip.

Although many thought the game elements were enjoyable, one participant reported that they were an unnecessary addition to a serious application: "*It keeps it simpler (without the game). I play games because I'm in the mood to play games but if I'm adding another game as well as driving it sometimes gets me distracted while I'm driving.*"

8.2.5 SUMMARY OF THE FIELD STUDY RESULTS

Results suggest that the for the most part, the gamification design did not positively or negatively affect the user experience although the gamified version was reported as being more enjoyable. The gamified version was also reported as being preferred over the non-gamified version by the majority of participants. Perceived motivation was significantly higher for the gamified version and participants recorded significantly more events when using it as well. However, there was no significant difference in the amount of recorded practice undertaken by participants between the two different applications. One participant did report that they cheated in the gamified version, and one also in the non-gamified version.

8.3 FIELD EXPERIMENT DISCUSSION

It was expected that by using the updated gamification design framework, an effective gamification design would be created. The results of the field study indicate that the gamification design created had a significant effect on enjoyment and motivation, but had a mixed effect on the behaviour change. However, external factors may have influenced this construct. Participants also reported that the added gamification design provided clear goals and feedback for the activity, which can be seen as better supporting the activity. These results suggest that the framework was useful for designing an enjoyable and motivating gamification experience. There were also very few issues found with the gamification design – only a few minor design issues could be addressed in future versions of the application. Some additional changes to the framework could be made based on these results.

8.3.1 THE EFFECTS ON USER EXPERIENCE

Apart from enjoyment, the added gamification had little significant effect on the other user experience constructs measured. However, the added game elements did not negatively affect the user experience either. Adding game elements has the potential to affect the usability of an application (e.g., Flatla et al., 2011; Guin et al., 2012). Results from the logbook study found that generally the medians for usability-related results were high for both versions of the application. These results suggest that the participants found the gamified version just as useful and usable as the non-gamified version. This indicates that gamification design framework was useful at helping to successfully integrate game elements into the application without affecting the usability. This is a similar result to the findings of the orientation field study. However, unlike the orientation field study, the gamified application in this study was reported as being significantly more enjoyable.

The majority of participants reported that they preferred the gamified version. The qualitative analysis of interview responses indicates that participants also preferred both versions of the application to the physi-

cal logbook. However, this did not mean that all users preferred the gamified version. Another user group emerged made up of five participants who preferred the non-gamified version. These participants reported that the reason for this was that the non-gamified version was simpler and more straightforward. Also, similarly to the previous orientation study, different participants reported that they liked different aspects of the gamification. These included competition, collecting coins, upgrading their car, and collecting achievements.

8.3.2 THE EFFECT ON PERCEIVED MOTIVATION WAS POSITIVE

Participants reported that the gamified version was significantly more motivating than the non-gamified version of the application. A number of participants especially liked the link between the game elements and undertaking practice in real life. The gamification was more meaningful as participants found that the road trip was useful at helping them to visualise real life progress. This seemingly made the driving experience more interesting and motivating for some participants and may have influenced the motivation results. This indicates rather than just being arbitrary rewards, the goals of the gamification experience linked well to the driving activity. This supports the choice to address the antecedents of flow in the gamification design framework.

8.3.3 THE EFFECT ON BEHAVIOUR CHANGE WAS MIXED

Although reported motivation was affected, a comparison of recorded practice over the four weeks found that the addition of game elements did not lead to a significant increase in the amount of practice undertaken by participants. This indicates that the game elements alone are not enough to affect the motivation of the participants during the study. A number of reported external factors reported by participants may influence the amount of practice a learner can physically undertake.

Although the total amount of practice was not significantly different, it was found that participants recorded that they undertook significantly more driving skills when using the gamified version. This indicates that the added game elements managed to encourage participants to undertake different driving skills, or at least to record them. For every skill

that the learner recorded, they were rewarded with bonus coins that they could use to upgrade their car in the game. This was potentially an influencing factor, and interview results support this finding.

For recording different contexts in which they drove there was no significant difference measured between the two applications. It is hypothesised that this could have been because contexts may be more difficult to undertake. Driving skills such as U-turns and parallel parking can be performed fairly easily in most practice sessions, however different driving contexts like highway driving require specific routes to be undertaken, or contexts like driving in the rain rely on the weather. It is easier for a participant to undertake skills than to drive in different contexts, which may have led to this result.

One thing that may have improved these results was to help provide planning and notifications for different skills and contexts. Currently the application provides a list of contexts and skills for learner drivers to check off at the end of a practice session. It may have been worthwhile instead to also provide a list that the learner driver could review before they went driving and allow them to choose some they would like to undertake. This list could be personalised to suggest skills that have not been practiced in a while. In addition to this notifications could be implemented that make learner drivers aware of potential upcoming contexts that may be useful for them to practice in. For example, if rain is forecast for the following day, than alerting them the day before of this might encourage them to plan a session for the following day, thus encouraging more diverse practice. This area of personalisation could be considered further in the gamification design framework.

8.3.4 THE GAMIFICATION EXPERIENCE WAS POSITIVE

The results suggest that the game elements were well received by participants and that very few issues arose with the gamification design. Questionnaire and interview results suggest the participants enjoyed the game elements. Although six participants said that they would pre-

fer the non-gamified version, this was generally because of the context the game elements were being applied to, and not the game itself. One of the six did describe the gamification experience as underwhelming, because the use of the word 'game' implied to them a complete gaming experience comparable to some industry games. There were no issues with the alignment of the game goals and the goals of the activity. In fact, participants reported that the gamification experience supported the activity well by providing feedback in terms of their overall distance driven, and also by providing the goal to drive around Australia. Different participants enjoyed different parts of the game, indicating that the gamification design catered well for different player types and motivations. This indicates that the gamification design framework was useful in this context, and could possibly be useful to design gamification for other contexts in the future.

The gamification design framework also outlines six problems that may arise when adding game elements to a non-game experience. These problems were considered during the gamification design and the results of the study suggest that very few of the participants experienced any of the issues while using the gamified application. The only issue that was discussed in detail was that some participants were unsure if the gamification experience would provide long-term engagement over the entire period they were learning to drive. Running a longer study in the future would help to determine the long term enjoyment.

Although one participant admitted to cheating while using the gamified application, qualitative results suggest that very few other participants would cheat. It was interesting to note that one other participant 'cheated' in the non-gamified version as well. Both of these participants may have simply been testing the boundaries of the system, and whether they would continue to cheat needs to be investigated further. One other participant noted that the game elements might lead to distractions while driving and potentially danger. However, this was more of a concern rather than the participant reporting that they were personally distracted. Results from other participants suggest the gamification design would distract or cause dangers while driving.

8.3.5 FRAMEWORK EFFECTIVENESS AND UPDATES

The results of this study show that the gamification design framework has proven useful when designing gamification for this particular context. The use of the framework to develop a gamified logbook application led to results that suggest it was significantly more enjoyable and engaging than a non-gamified version of the same application. The addition of game elements to a non-game system has the ability to create a game-like experience for user. Looking at a gamified system as both a tool and a game means that a more effective experience can be designed – one that is not only usable, but is also enjoyable to play. The framework provides a closer focus on this duality of gamified systems, and presents a way in which to consider the effective design and evaluation of such a system. Running both usability and playability studies, as well as considering the six potential gamification issues, proved to be a successful way to create an enjoyable gamification experience with very few issues.

Although an effective gamified logbook experience may have been created, there are some key improvements that could be made to the gamification design framework in order to make it more useful. Notably, in its current state it may prove difficult for other people to use the framework for design gamification experiences. This is primarily due to *Step 6: Design the Game* being quite vague. Designing a game is a large undertaking, and without game design experience or a detailed example, then this step is going to be difficult to achieve. To address this, further tools and activities need to be provided with the framework in order to guide the designer through the process. For example, a more explicit approach to describing the game could be used, such as using the formal elements of game systems (Fullerton, 2014). A gamification design document template could also be provided to help guide designers.

The second area for improvement could be to provide further guidelines on how to use the framework for evaluating existing gamification designs. As discussed in Chapter 2, the three layers of the initial framework can be used to break down existing gamification designs.

However, how the existing framework could be used to then evaluate gamification designs is unclear and needs further work.

8.3.6 COMPARISONS TO THE ORIENTATION STUDY

It is difficult to compare the results of this study to the results of the orientation study because the two contexts are different. However, the participant demographics are similar which, does allow for some informal comparison. Results suggest that the logbook design was a more effective gamification design as the achievement design used in the orientation study did not affect general user experience, perceived motivation, but had a little effect on the number of check-ins and friends added. The gamification design used in this study however had a positive affect on enjoyment, perceived motivation and on some behaviour change. The design also linked better to the activity, providing better feedback and goals to the actual practice being undertaken.

8.3.7 STUDY LIMITATIONS

Limitations of this field study include application novelty, length of study, number of participants, and moderating variables in terms of driving engagement. The novelty factor of both versions of the application may have contributed to higher user experience results when compared to the paper-based logbook that learner drivers currently use. The length of the experiment meant that each application was used for a minimum of two weeks. Although this was a good length in terms of gathering application data and feedback, a longer study may have provided a clearer picture of the effect of the gamification elements on long-term driving motivation. There were also a number of external factors that may have affected the amount of driving practice undertaken by participants. These, discussed earlier, primarily revolved around relying on the availability of their supervisor to undertake practice.

8.4 CHAPTER SUMMARY

This chapter outlined the results of a month-long field experiment with learner drivers that explored the effect of adding gamification to a logbook application, using the updated gamification design framework

from chapter six. Results indicated that the gamified application was preferred over the non-gamified version of the application. The results from this study also suggested that the addition of game elements had a positive effect on reported enjoyment and engagement. Even though adding game elements can add a level of complexity to a system, results indicated that the addition of game elements did not affect the perceived ease of use of the gamified application. Results were mixed when it came to driving engagement – the added gamification led to a significant increase in reported motivation, however, there was no significant change in total recorded practice. Participants did record themselves as undertaking significantly more driving skills when using the gamified version of the application. The qualitative results suggest that the potential gamification problems proposed in chapter six were addressed well with this particular gamification design. These results suggest that the gamification design framework is a useful tool that aided in the design of an effective gamification experience.

9. CONCLUSION

Over the last few years there has been an increase in the number of designers using game elements in non-game contexts to motivate and engage users. The term *gamification* has been used to describe this engagement strategy, and a sizeable industry has grown that provides gamification services. While research has demonstrated that gamification can be effective at producing behaviour change, studies have found that it may also negatively affect the user experience or even motivation. In addition to this, there are very few guidelines that exist to aid designers in creating an effective gamification design. This thesis has investigated these gaps further, contributing an iteratively developed gamification design framework that has been used to design two gamified systems that have been tested in the field. The results of this research suggest that gamification can be used to engage and motivate users without greatly affecting the user experience. However, when designing gamification, designers may want to look beyond using extrinsic reward and competitive elements alone. Also, careful consideration is also needed during the design process, as problems unique to gamification can arise. This chapter summarises the research investigation, the contributions, and the limitations and future research.

9.1 RESEARCH INVESTIGATION

As gamification techniques become more popular, there is a need for research to explore whether it is a valid and viable design strategy. Results from previous gamification research have indicated that adding game elements to non-game contexts can create more motivating experiences in some contexts. However, research also found that adding game elements has the potential to negatively affect the user experience and can also lead to undesired behaviours, such as cheating. These results suggested that the effects of gamification depend greatly on the design of the gamification itself. Therefore, in addition to determining the viability of gamification as a design strategy, this research investigation also explored contributing factors to effective gamification design.

Using the findings from the literature review, a gamification design framework was proposed. The framework was used to design a gamification experience for a university orientation application. Notably the gamification design focused on using achievements, a popular game element used in many gamification implementations at the time. The theory being that the addition of achievements to this non-game context could engage and motivate students to undertake orientation activities. An analysis was undertaken of achievement systems used in previous games and gamification implementations. From the analysis, an anatomy of an achievement was proposed and was used, along with the gamification design framework, to design a set of 20 achievements for the orientation application. An iterative design process was used to create the gamification, with feedback gathered from staff and students.

A field study was undertaken with 46 new students testing either a gamified or non-gamified version of the application. It was hypothesised that adding an achievement system would enhance user experience, perceived motivation and behaviour change. However, results suggested that the addition did not significantly affect the user experience or perceived motivation. Although behaviour change was recorded, some cheating did occur as well. The gamification experience was nonetheless positive, and participants were willing to complete a number of achievements. It was also noted that participants stopped engaging with application functions, such as checking-in to events, when there were no achievements attached to them. These results suggested that the addition of an achievement system did not have a positive or negative impact on the experience overall.

Using the findings from the field study, two primary updates were made to the gamification design framework. The first revolved around including design and evaluation techniques related to game design, in order to promote the creation of a more intrinsically motivating gamification experience. The second was the addition of six heuristics to address six potentially problems unique to gamification design (e.g., cheating).

The updated framework was used to design a gamification experience for a learner logbook application. This time, the gamification design focused on creating a more game-like experience; by understanding the target player demographic, developing a design document, and using playability testing to evaluate the enjoyment of the gamification. The theory this time being that by using these techniques to a more game-like experience could lead to a more effective gamification design that encouraged learner drivers to undertake more diverse driving practice. An iterative design process was also used to create the gamification, and a usability and playability study was undertaken before the application was deployed in a field study.

A field study was undertaken with 25 learner drivers testing both a gamified and non-gamified version of the logbook application. It was expected that by using the updated gamification design framework, an effective gamification design would be created. The results of the field study indicated that the gamification design had a positive effect on enjoyment and motivation. Behaviour change results were mixed, the gamification encouraged drivers to try more driving skills, but not practice anymore overall. External factors are likely to have influenced this (e.g., supervisor availability). Overall, the results from the study suggested that the framework was useful for designing an enjoyable and motivating gamification experience that provided clear goals and feedback to the driving activity. A few minor design issues could be addressed in future versions of the application

To conclude this section, the research questions from chapter one are restated and answered based on the results.

Research question: How can an effective gamified system be designed?

In chapter 2, *effective gamification* was defined in terms of four aspects: user experience, perceived motivation, behaviour change, and gamification experience. The first is that the added gamification should not affect the user experience of the application, including both hedonistic and utilitarian qualities of the experience. The second is that the resulting gamification design should result in the user feeling motivated to

undertake the non-game activity. The third is that the gamification should encourage some sort of positive behaviour change. The fourth is that the gamification experience should be fun, enjoyable, and without play-breaking issues, such as cheating.

The results from the logbook field study in chapter 7 suggest that using the updated framework resulted in a somewhat effective gamification design being created – more so than the orientation gamification design. This suggests that in addition to an iterative design process, designing the gamification using game design and evaluation processes may benefit the design. Understanding whom the target player is, what they like in terms of game experiences, and playtesting with the target player may be important. Also, considering potential problems unique to gamification that may arise. The updated framework presented in chapter 6 provides a starting point for gamification designers to help them design an effective gamification experience.

Research question: What are some of the potential negative effects or unintended consequences that occur when game elements are added to non-game contexts?

The results of the orientation study suggested that adding achievements encouraged participants to undertake orientation activities, notably checking-in to events. However, using reward-based game elements alone may not be the best approach to gamification design, as previous research has demonstrated that the use of expected tangible rewards may have a detrimental effect by undermining intrinsic motivation. The results of the orientation study found that adding achievements did not significantly affect participants' perceived motivation, and did not greatly affect behaviour change. It was also found that a couple of participants cheated when completing some of the achievements.

Central to the design of software applications are usability goals, with core aspects such as efficiency, learnability, good utility and ease of use. The goal of productivity software is to make a task easier to complete and should reduce workload. Video games on the other hand are meant

to increase workload, entertain players and be challenging. Video games need to also taking into account aspects such as challenge, fun and playability. When adding game design elements to motivate users in non-game contexts, the gamified application has the potential to be used like a tool *and* a game. When this happens there is a potential for conflict to occur between the goals of the tool and the goals of the game. From the results of the orientation study, and also from research and industry examples, six problems unique to gamification design were identified. To summarise, these problems include:

1. Games are voluntary: By making game elements mandatory, rather than voluntary, it may have a negative impact on the experience as it automatically subscribes users to the game. Users could feel forced to play or the game design elements may not appeal to all users.
2. Player enjoyment can wane: Once players work out the challenge or puzzle of a game, then they can become bored with it. Designs that rely on gamification may eventually find that players become bored with the game elements.
3. Goal misalignment: Gamification goals need to align with and support the goals of the tool, otherwise they may create promote unsuitable actions.
4. Distractions: adding playful elements to a tool may mean that time to complete the task may increase.
5. Cheating: By adding game elements, users may be encouraged to cheat. This may affect the experience of other players and also affect the quality of the tool.
6. Ethics and Safety: Adding game elements to non-game contexts that involve potentially risk activities may lead to dangers.

Research question: Which elements are required in a gamification design framework in order to guide effective gamification design?

Adopting game design and evaluation processes may help to create a more enjoyable and fun gamification experience. It was theorised that a game is effectively being created whenever game elements are added to a non-game context. Results from the orientation study support this theory that a game is being created – players found the activity enjoyable and game-related activities took place that normally would not when using the application (e.g., cheating). Results also suggest that designing challenging and fun game activities is important. Therefore, designing the gamification experience like a game is a worthwhile approach to effective gamification design – where the user is also considered a player, game design techniques are adopted and playability testing is undertaken.

To address the six gamification design problems, six heuristics were proposed in chapter 6 that could be used during the design process to identify and deal with the problems. These heuristics included:

1. Consider making gamification voluntary: any added game elements could be made an optional extra that can be turned on or off.
2. Tailor the experience to the player: Identify and design for the target player demographic to create an experience that is fun, challenging, and enjoyable for them.
3. Align the goals of the tool and the game: The goals of the gamification experience need to align to the goals of the system.
4. Minimise interruptions unless the user wants them: do not interrupt system tasks with game elements unless the user has explicitly indicated that they want to be interrupted.
5. Minimise the potential for cheating: Use multiple sensors to enforce game elements, or consider using crowd-sourcing to enforce game elements as well.
6. Highlight risks and add a disclaimer: Include a disclaimer and highlight any potential risks to the user if they exist.

Research question: Is gamification a viable strategy for promoting engagement?

The results from this research suggest that if designed well, gamification can be a viable strategy for engaging users. Results from both field studies found that the gamified version of the application encouraged some form of behaviour change in each context. However, further research is needed to investigate long-term behaviour change.

9.2 CONTRIBUTIONS

This study provides a number of contributions for both academia and industry. These range from more abstract, complete and mature knowledge to more specific, limited and less mature knowledge.

9.2.1 UNDERSTANDING GAMIFICATION

When gamification first started gaining momentum as an industry solution, a common theory was that the addition of any game element to a non-game context was a worthwhile design strategy. In particular many thought that the addition of points, badges, or leaderboards would often result in behaviour change and increased enjoyment. However, the literature revealed mixed results when it came to determining the effect gamification had on behaviour change, some had an effect and some did not. In addition to this, the literature also revealed studies where adding gamification negatively affected other constructs, such as user experience. The results of the orientation field study also supported these findings – although the addition of achievements encouraged some additional function use, there was no impact on user experience, and a number of problems arose in the design (e.g., cheating). Therefore, gamification needs to be designed carefully to increase the chances that it will elicit behaviour change, without affecting other constructs. Unfortunately there were no general gamification design guidelines found that could aid in the design of gamification for both academia and industry.

The theory was proposed that when game design elements are added to a non-game application, the application has the potential to be used as both a tool and a game, sometimes simultaneously. Results from both the literature review, and both field studies in this research support this theory that a game may be created around the tool. This game has the potential to influence the way the tool is used: either positively, by encouraging desired behaviour change; or negatively, by encouraging activities that are detrimental to the tool usage (e.g., cheating, distracting the user or promoting undesired behaviour change). This should be considered during the design of a gamified system, so that gamification-related problems are found and minimised.

If a gamified system can be played as a game, then designing it like a game could be a useful approach. Therefore, gamification design that supports the target player demographic and uses game design and evaluation techniques during the process may result in a more effective gamification design. The theory proposed is that if games are primarily enjoyable and motivating to the extent that they create an intrinsically motivating experience, then focusing on supporting intrinsic motivation in gamification designs may make them more effective. Results from the learner logbook field study support this theory.

9.2.2 GAMIFICATION DESIGN FRAMEWORK

A gamification design framework was proposed in chapter 6 to aid in the design of effective gamification. It provides guidelines for designing gamification, along with six gamification heuristics, and suggests gamification designers to follow three phases:

1. **Justify** the motivation and requirements for gamification
2. **Design** the gamification experience
3. **Evaluate** the gamification experience

Each phase contains a number of steps. The phases and steps combined make the updated gamification design framework (see Figure 9.1).

Figure 9.1 – Updated Gamification Design Framework

This framework can be used to aid in the design of future gamified systems for both research and industry applications. The gamification design framework may be used to help create new gamification experiences or even used to help evaluate existing gamification experiences. The aim of the framework is to provide a more structured process for effective gamification design: one that takes into account potential gamification problems that may not be present when using established HCI design methods and processes. Note that the framework is not meant to replace existing methods and processes. In fact it may work better when used alongside a user-centered and iterative design approach. Six heuristics were also proposed to address six potential gamification problems that may arise during design. These heuristics were outlined earlier in this chapter.

The framework was developed through an iterative 'build-evaluate' process, where an initial framework was proposed in the literature review in chapter 2, and this was used to add gamification to an orientation application. Changes were made to the framework based off the results of a field study that investigated the effectiveness of the orientation gamification design. The updated gamification design framework was used to design gamification for a learner logbook application. A field study was also undertaken to evaluate the effectiveness of this gamification design.

9.2.3 IMPLEMENTATIONS

This research has also resulted in two gamified iOS applications. The first, an orientation event application for new students has been used at the Queensland University of Technology orientation event for three years and is still in use (see Figure 9.2).

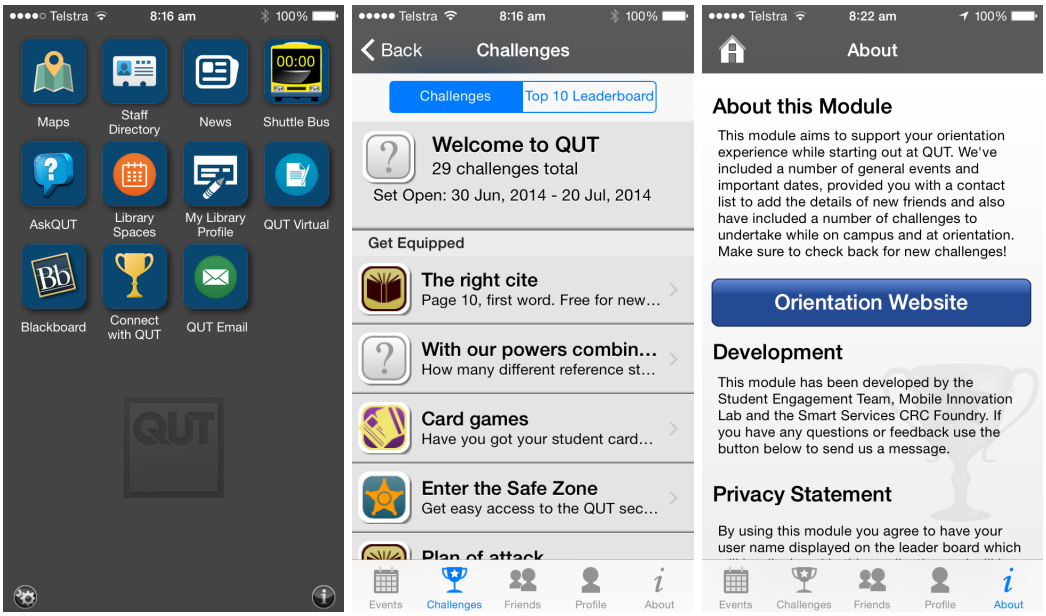

Figure 9.2 – The gamified 'Connect with QUT' module in the QUT iPhone app

The application is available to all staff and students at the university and has been updated a number of times. Additions to the application include: an event list that automatically populates with the events a student has signed-up for via the event website, leaderboards for each set that list the top 10 students who have completed the most achievements in that set, and a enter prize draw button that allows students to send an email to orientation staff when all achievements of a particular set have been completed.

The second application is a gamified learner logbook application for Australian learner drivers to be released on the Apple App Store in the near future (see Figure 9.3).

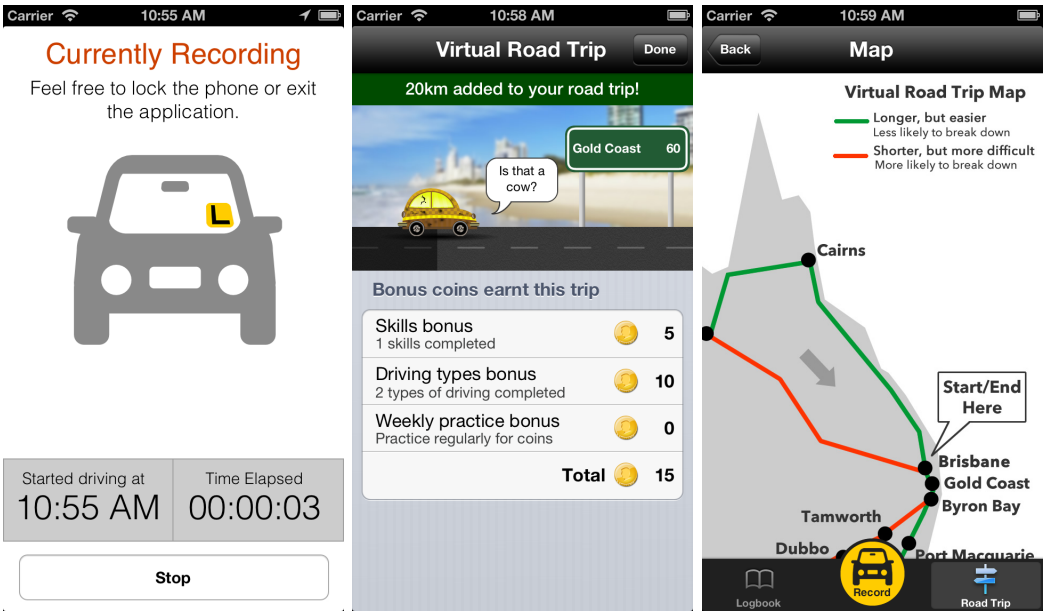

Figure 9.3 – The gamified learner logbook application with the virtual road trip

This application is mostly identical to the application produced for the field study, with minor changes being made to the interface to align it to iOS 8 human-interface guidelines.

9.3 LIMITATIONS AND FUTURE RESEARCH

This study has a number of limitations. These are detailed in this last section, along with suggestions for future research.

9.3.1 LIMITATION 1: SMARTPHONE FOCUS

The proposed gamification design framework aspires to be used as set of general guidelines that can be used for any platform. However, currently the focus on smartphone applications does potentially limit the ability to transfer the results of this research to other contexts. Generally speaking, the framework could be employed relatively easily to the design of gamified computer applications and websites, as well as non-digital contexts. A limitation in these domains would be the range of

sensors available for gamification input. Where a smartphone provides a range of different types of input (e.g., location, movement, direction), a desktop computer is more limited. In this case, it is likely that the designs would rely instead of different types of sensing, such as crowdsourcing. Additionally smartphones are generally always on and always connected to a network. This provides a number of additional advantages when it comes to gamification – passive sensing can sense activities when the device is not being actively used, and notifications can be sent to users to re-engage them with the gamified experience when they have not used it for some time.

Ultimately the steps of the framework are general enough that they could be followed in a similar way to create gamification experiences for different contexts. However, further research and work would be required to understand the effectiveness of the framework in these different contexts.

9.3.2 LIMITATION 2: FIELD STUDY NOVELTY AND DESIGN

There are a number of limitations of the orientation study – most notably the small sample size, the length of the study, and the novelty of the applications. Future research should seek to replicate these findings with a larger sample and over a longer timeframe. Finally, the current study utilised a number of single-item measures and non-standard scales. Future research should seek to confirm these findings using established and validated scales.

A few limitations of this logbook study included the application novelty, length of study, and number of participants. The novelty factor of both versions of the application may have contributed to higher enjoyment results when compared to the paper-based logbook that learner drivers currently use. The length of the study meant that each application was used for a minimum of two weeks. Although this was a good length in terms of gathering application data and feedback, a longer study may provide a clearer picture of the effect of the gamification elements on long-term behaviour change.

9.4 FINAL REMARKS

As gamification becomes a more popular design technique in both research and industry settings, it is important to investigate effectiveness of the approach. The findings of this thesis contribute to this area, presenting a design framework to aid in creating effective gamified systems. Ultimately this thesis contributes to a better understanding of the design and impact of gamification as a design strategy, and how gamification can be used effectively to promote positive change.

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11. APPENDIX

11.1 ACHIEVEMENT SYSTEM ANALYSIS

11.1.1 GIANT BOMB WEBSITE

Giant Bomb is an online video game community website which used to integrate game elements into user profiles in order to encourage activity amongst the community members and the site. It automatically awards achievements to users for various activities (e.g., create a profile). Achievement notifications appear as popups in the current web page that users are viewing, and an overview of achievements and their sets could be found in each user's profile. The achievement system was eventually removed from the website.

Platform: Web-based application

Statistics:

- Launched in 2008
- 332,559 Visits in September 2010
- 5:19 Average Visit Time
- Nearly 20% of the audience visits the site more than 200x per month

Language:

- Achievements are called "quests"
- Achievements are grouped as themed "sets"
- When a user completes an achievement they "complete a quest"
- When a user completes a set they receive a certain amount of "experience points" based on the difficult of the quest undertaken
- A user can gain "levels" based on the amount of experience points they have received from completing sets

Achievement System Overview:

- Sets: Quests are grouped as sets with common themes, for example the set "Broadcast News" contains four quests that relate to connecting social networks to a user's account, such as Twitter

and Facebook, and then updating these accounts from the GiantBomb website. A set includes the following:
    - Title: provides an overview of the set with a theme that the quests may follow
    - Total quests: Number of quests in the set
    - Total quests completed: Number of quests completed
    - Set difficulty: Provides information on how easy a set is to complete based on a colour-code (eg. Easy sets are green, Uncommon are blue, and Rare are purple)
    - Experience points: The number of experience points that will be received when completing a quest.
    - Finish number: A number telling you how many other users have completed the set before you (E.g., a user was #15,283 person to finish this set).
- Quests are achievements that contain:
    - Title: provides an overview of the achievement, usually amusing, referencing video games, and it may not be obvious as to what is required to complete the achievement just by looking at the title.
    - Image: Provides an image that often gives you a clue to the quest. The image is black and white until the quest is complete, then it changes to colour.
    - Description: Provides a hint as to what is required to complete the quest (E.g., "What are you up to right now? Let us know by adding a status update.") The clue changes into "Quest Complete" text once complete. It also provides details on what you did to achieve the quest (e.g., "You told us what you were up to and updated your status. Nice work").
    - Progress: One or more steps are required to complete each quest, until they are complete they will often provide the text "Read the clue above" for each step. Once the step is completed it will provide text explaining the step required to complete the achievement. (E.g., "You updated your status at least once"). Some quests require the user to repeat

the same step a number of times, this will be counted in the step using a progress bar.
    - Feedback: a popup in the bottom right-hand corner of the screen displays quest status, whether a quest was completed or a step of a quest was completed.
    - Reward: Provided in the form of "experience points" for completing each individual quest. The number of experience points received is hidden until the quest is complete. Once complete it lists how many experience points were received for the quest.
    - Limited Edition: These quests run for a particular time and then expire after a certain date.
    - Sponsored Quests: Some quests are sponsored by a company – most likely used as a source of revenue.
- Overview: Listed on the user's quest page is an overview of quests and sets completed, and experience points gained (E.g., the page will list rarest set, rarest quest, fastest set, easiest set you don't have yet, total XP earned by quests, # of limited edition quests completed, number of quests completed out of the total, number of sets complete out of the total). This allows the user to make informed choices about what they can complete next.
- Levels: A representation of total progress with quests. The level of a user is listed next to their name in their profile and can be viewed by any other user.

11.1.2 XBOX 360 ACHIEVEMENTS

Achievements are included in all Xbox 360 retail games (not including Indie Games and Xbox Originals) that unlock when certain in-game tasks are completed. Each achievement has a "gamerscore" associated with it and for each retail game the sum of all achievement gamerscores generally added up to a total score of 1000G. For indie games a gamerscore of 200G was initially available. As players complete achievements, the score of each completed achievement is added to their overall gamerscore, which is displayed in a player's profile.

Platform: Xbox 360 Game Console

Statistics:

- The Xbox 360 Launched in 2005
- 83.26 million units shipped (VGChartz, 2014)
- 48 million accounts (McCormick, 2013)

Language:

- Called "Achievements"
- Achievements that have not been completed are listed as "locked"
- When you complete an achievement you "Unlock" it
- The "gamercard" summarises a player's profile and includes a "gamerscore", which is the total sum of all points attained from unlocking achievements in games

Achievement System Overview:

- Players can view their friend's gamercard with their gamerscore
- Although there is no direct measure of how difficult an achievement is to complete, the score associated with each achievement may provide an indication of how difficult it is to complete. Usually achievements with larger scores will be more difficult to unlock.
- An achievement includes:

- Title: provides an overview of the achievement, sometimes it may be amusing and not obvious what is required of the achievement just by looking at the title .
- Image: Provides a unique image that accompanies the achievement. The image is provided by the game developer and will often link to the game aesthetic.
- Description: usually provides some description of what is required to complete an achievement (E.g., Escape the hideout).
- Progress: Some achievements require the user to repeat an activity multiple times before unlocking an achievement (E.g., For the Keptomaniac achievement in in Assasin's Creed the player is required to "Pickpocket 1000 Florins").
- Feedback: a popup will appear in the game when an achievement has been completed.
- Reward: Once an achievement is completed it becomes unlocked, the score of the achievement is added to the player's gamerscore, and the game's achievement progress is updated.

11.1.3 FOURSQUARE

Foursquare was a mobile-based location sharing service that launched in 2009. It allowed users to "check in" to locations (e.g., coffee shops, parks, airports) and share their location with friends. Users could earn "badges" for checking into different venues. Foursquare has since split the service into two separate applications (Swarm and Foursquare) and achievements have been from the service.

Platform: Mobile and Web-based application

Statistics:

- Launched in 2009
- 45 million registered users (Crowley, 2013)

Language:

- Achievements are called "badges"
- When a user completes an achievement they "Unlock a badge"

Achievement System Overview:

- Badges are achievements that contain:
    - Title: provides an overview of the achievement, and a hint at what may be required to unlock it.
    - Image: Provides an image that links thematically to the badge. The image is a grey-scaled star until the quest is complete, then it changes to a coloured and themed image.
    - Feedback: a screen appears when an achievement is unlocked that provides an overview of it and an unlock message.
    - Limited Edition: These achievements ran for a particular time and then expired after a certain date.
    - Sponsored Badges: Some badges were sponsored by a company – most likely used as a source of revenue.
    - Hidden Badges: Some badges were hidden until they were unlocked.
- Overview: Listed on the user's badges page is an overview of badges unlocked

11.2 LIST OF ACHIEVEMENTS CREATED FOR THE ORIENTATION APPLICATION

1. **Participate Set - Welcome to QUT Orientation 2011 (1/1)**
    a. Name: Roll out the red carpet!
    b. Image: Building with QUT logo and a red carpet leading to it.
    c. Clue: Check into QUT Orientation when you arrive on campus using the button below.
    d. Trigger: GPS - GP Campus.
    e. Description: You've arrived at the official QUT orientation! This app will help you get around the campus, meet others and see what's on offer. Complete the achievements listed here to gain levels, learn more about QUT and become an orientation master!
2. **Participate Set - Event Manager (1/3)**
    a. Name: Roll call.
    b. Image: Calendar with the number 1 in front of it.
    c. Clue: Did you know this app let's you check into events when you attend them? Click the event you're currently attending and press the check in button to complete this achievement.
    d. Trigger: Event total = 1
    e. Description: All right! You're off to a good start! Attending events is essential to getting the most out of QUT Orientation. The events page will help you keep track of upcoming events and events you've attended. This feature only works if you're at the right place at the right time so don't forget to check in!
3. **Participate Set - Event Manager (2/3)**
    a. Name: Two events are better than one.
    b. Image: Calendar with the number 5 in front of it.
    c. Clue: Check into your second event.
    d. Trigger: Event total = 2.
    e. Description: Your second event already? I'm impressed, keep it up! You've got one more achievement left to complete in this set.

4. **Participate Set - Event Manager (3/3)**
    a. Name: Third time's a charm.
    b. Image: Calendar with the number 3 in front of it.
    c. Clue: Check into your third event.
    d. Trigger: Event total = 3.
    e. Description: Nice work! That's this set complete, you'll be an orientation master in no time.
5. **Social Networking Set – The Real Social Network (1/3)**
    a. Name: Friend request accepted!
    b. Image: a silhouette of one person
    c. Clue: To complete this achievement find someone with the same app and then see if you can add them on the friends page.
    d. Trigger: Friend total = 1.
    e. Description: There are so many people at orientation so how do you keep track of them all? Easy, add them to your Official Orientation Contact List. Not only does this provide you with an easy way to contact them but you can see their orientation stats as well.
6. **Social Networking Set - The Real Social Network (1/3)**
    a. Name: Two's company…
    b. Image: silhouettes of two people
    c. Clue: Add your second contact.
    d. Trigger: Friend total = 2.
    e. Description: You've got two contacts already? Nice! You've just got one more to add before you complete this set
7. **Social Networking Set - The Real Social Network (1/3)**
    a. Name: Three's a crowd.
    b. Image: silhouettes of three people
    c. Clue: Add your third contact.
    d. Trigger: Friend total = 3.
    e. Description: Three friends! That's this set complete!

8. **Participate Set – Equipped (1/2)**
    - **a.** Name: Card games.
    - **b.** Image: student card
    - **c.** Clue: Have you got your student card yet? If so, tell us how many times your picture appears on it to unlock this achievement.
    - **d.** Trigger: Number input = 1
    - e. Description: Staff, students and official visitors are required to carry their QUT issued identity cards at all times so that they can easily establish their identity. The QUT ID card is also an access card, giving authorised personnel swipe access to secure areas within the University. QUT staff and students will be able to travel free on the intercampus shuttle bus route 391 when they show the driver their QUT identity card. You can use your ID card for any print and copy services and can top up your account anytime online. You can also borrow books with it and get student discounts! Who needs a Lvl. 41 Sword of Awesome when you're equipped with your all-powerful student card!
9. **Participate Set – Equipped (2/2)**
    - **a.** Name: Tee-riffic.
    - **b.** Image: t-shirt
    - **c.** Clue: Make sure to find the QR code when you pick up your free QUT-shirt. Here's a hint: It's near the open sign of this place…
    - **d.** Trigger: Barcode = "http://www.fmd.qut.edu.au/bookshop"
    - e. Description: You've got your free tee then? Did you know that the t-shirts are designed by a QUT graduate and they've become a 'must have' item every year. If you haven't got yours yet take your QUT Student ID Card or your QUT Current Unit Enrolment Statement to the QUT Bookshop on Gardens Point or Kelvin Grove campuses during O Week from 21–25 February.

10. **Explore Set – Campus and Services (1/7)**
    a. Name: Book worm
    b. Image: book
    c. Clue: The QUT library is a big place, just how big? Let us know how many levels there are in this building to unlock this achievement. Hint: Looks can be deceiving.
    d. Trigger: Number input = 6
    e. Description: During your time here you most likely visit the library frequently. There is plenty to do here, books to browse and borrow, computers downstairs, printing services, assignment minder and the IT helpdesk as well. Speaking of which, have you completed that achievement yet?
11. **Explore Set – Campus and Services (2/7)**
    a. Name: Have you tried turning it off and on again?
    b. Image: computer broken
    c. Clue: The IT Helpdesk service desk can be found in the library but if you wanted to contact them via phone them what number would you call?
    d. Trigger: Number input: 3138 4000
    e. Description: The IT Helpdesk provides support to all students for QUT's online environment as well as computers and software. You can request assistance from the IT Helpdesk in person, over the phone (3138 4000) or via email (ithelpdesk@qut.edu.au).
12. **Explore Set – Campus and Services (3/7)**
    a. Name: Art Attack!
    b. Image: building
    c. Clue: Did you know QUT has an Art Museum? Find the Art Museum, find the QR code. It's closed on Monday though so if you're looking for it then you'll find it near the back entrance…
    d. Trigger: Camera scan – QR code "http://www.artmuseum.qut.edu.au/"
    e. Description: The QUT Art Museum is definitely a highlight here at QUT Garden's Point. It's open Tuesday, Thursday

and Friday from 10:00am until 5:00pm and on Wednesday from 10:00am until 8:00pm.

13. **Explore Set – Campus and Services (4/7)**
    - **a.** Name: Center of attention.
    - **b.** Image: building
    - **c.** Clue: On what level of A block can you find the student center?
    - **d.** Trigger: Number input = 1
    - e. Description: Each QUT campus has a Student Centre – a one-stop shop for all student queries. The Student Centres are especially useful during the first few weeks of semester and employ current students, who remember what it was like on their first day, to help new students find their feet. Student Centre staff will help you with enquiries regarding admission, advanced standing, enrolment, fees, student ID cards, transport concessions, and other student administration or general enquiries.
14. **Explore Set – Campus and Services (5/7)**
    - **a.** Name: Due East-West
    - **b.** Image: letters EW
    - **c.** Clue: Head to the East West tent and find the QR code!
    - **d.** Trigger: QR code = "http://www.eastwest.com.au"
    - e. Description: Have you heard of The East West Centre? It's designed to celebrate and acknowledge our diversity and to enhance your student life at QUT. Our aim is to create an arena for students of all backgrounds to meet and learn about each other in a safe and supportive environment. Make sure to check out the website http://www.eastwest.qut.edu.au/ for information at some great upcoming events.
15. **Explore Set – Campus and Services (6/7)**
    - **a.** Name: Who ya gonna call?
    - **b.** Image: whistle, or security badge.
    - **c.** Clue: *What 8 digit number would you need to contact QUT security?*
    - **d.** Trigger: Number entry – security number, no spaces.

e. Description: They might not bust ghosts but in case you needed to contact them QUT has security arrangements on QUT campuses which include a 24-hour patrol service, sophisticated keying and entry systems, fire safety precautions, emergency procedures, and a night security bus service for students. Security unit staff respond to problems on campus, escort students and staff at night, oversee after-hours access to university buildings, and ensure compliance with laws and regulations on campus. The Security Emergency Line: 07 3138 8888, or extension 88888. Australia's emergency phone number is 000 (triple zero) for fire, police, and ambulance. Security Help Desk: 07 3138 5585, or extension 85585. Free call: 1800 06 5585.

16. **Explore Set – Campus and Services (7/7)**
    - **a.** Name: Hail to the bus driver.
    - **b.** Image: bus stop or bus.
    - **c.** Clue: We're looking for the three digit route number of the intercampus bus, enter it to unlock.
    - **d.** Trigger: Number entry – bus number 391
    - **e.** Description: Need a lift to the other QUT campus? Never fear, QUT provides a free shuttle bus service to assist students and staff travelling between the Gardens Point and Kelvin Grove campuses for the purpose of attending lectures or attending to University business. The 391 service is operated for the University by TransLink. QUT staff and students are able to travel free on route 391 but will need to show the driver their QUT identity card.
17. **Explore Set – Lunch Break (1/2)**
    - **a.** Name: Food, glorious food.
    - **b.** Image: food
    - **c.** Clue: Including the new coffee cart, how many different places can get food from on Level 3 of L Block?
    - **d.** Trigger: Number input = 5
    - **e.** Description: QUT offers many enjoyable options for eating and drinking. Refectories serve juices, sandwiches, snacks, hot dishes, Halal, and vegetarian meals. Stylish cafés offer

excellent coffee and light meals. Also, the QUT Student Guild runs a licensed club on each campus.

18. **Explore Set – Lunch Break (2/3)**
    - **a.** Name: Caffeine Hit.
    - **b.** Image: cappuccino
    - **c.** Clue: How many different takeaway sizes exist at Merlo's café?
    - **d.** Trigger: Number input = 2
    - **e.** Description: We know how important coffee can be so you'll find it and many other enjoyable drinking options readily available all over campus. At Garden's point you'll find stylish cafés that offer excellent coffee and light meals. Bar Merlo, a licensed café at Gardens Point campus, offers coffee, pastries, cakes, and light meals. Artisans Café on the same campus serves fresh juices, coffee, meals, cakes, and pastries.
19. **Explore Set – Lunch Break (3/3)**
    - **a.** Name: Sugar Rush.
    - **b.** Image: sweets
    - **c.** Clue: Did you know there's a lolly shop on campus? On what level of L Block can you find it?
    - **d.** Trigger: Number input = 2
    - e. Description: Not only does the GP campus show sell a whole lot of lollies, but it also stocks a wide range of everyday products in case you need them. It's open Mon - Thurs from 8.30am - 6.00pm and Fri from 8.30am - 4.00pm
20. **Difficult Set – Game on! (1/1)**
    - **a. Name:** 025.344 15
    - b. **Image:** question mark
    - c. **Clue:** ???
    - d. **Trigger**: Camera scan – Scan the book Game On
    - e. **Description**: Well done, this one was meant to test you and I'm impressed, you completed it! Thanks for playing the game enjoy the rest of your time at QUT Orientation.

11.3 INTERVIEWS WITH LEARNER DRIVER EXPERTS

Key findings from the analysis indicate that novice driver crash risk is a concern both nationally and internationally yet it is also clear that there is no one solution for decreasing the crash risk of novice drivers. It is indeed a complex situation with the interviewees presenting many different factors that influence it. However there were some key areas raised and discussed and in particular inexperience was discussed in depth as a recurring issue by the majority interviewees. Interviewees were positive regarding the changes to the graduated licensing system in 2007, however they did raise some interesting issues that some novice drivers may face when attempting to accrue the mandatory 100 hours. The interviewees also provided opinions and feedback on the idea for a smartphone logbook application as a replacement for the physical logbook.

From the analysis of the interview data, three main themes emerged:

1. Novice Driver crash risk is still an issue in Queensland
2. Research and statistics suggest the changes to the GDLS in 2007 have lowered the crash risk of novice drivers, but there are still opportunities for improvement
3. A logbook app for smartphones could be a positive way to address these opportunities

11.3.1 SUMMARY OF THEMES AND RESEARCH FOCI

From the analysis of the interview data, three main themes emerged:

1. Novice Driver crash risk is still an issue in Queensland
2. Research and statistics suggest the changes to the GDLS in 2007 have lowered the crash risk of novice drivers, but there are still opportunities for improvement
3. A logbook app for smartphones could be a positive way to address these opportunities

Crash risk is still an issue for novice drivers in Queensland, and interviewees believe that ***inexperience is a recurring key issue*** for the novice driver, in particular when combined with other factors such as age, behaviour and lack of supervision and overcoming the jump in perceived skills after receiving the provisional licence. One way to help combat this problem could be for a learner driver to ***gain as much diverse and relevant experience as possible***, while supervised in the learner phase, as this is the safest period for any driver.

From what the interviewees discussed, research and statistics have indicated that the changes to the graduated driver licensing system (GLDS) in Queensland, in particular the mandatory 100 hours, has been a beneficial move towards lowering the crash risk of novices. However there is still room for improvement as the **100 hours is a crude measure** which focuses on driving time rather than driving experience. **More guidance could be provided** as to how to complete the 100 hours - guidance for what kind of practice should be undertaken and how often in order to encourage as much varied experience in the learner stage as possible. **Supervisors could also be engaged further**, as the process of supervising can be tedious for them. The logbook is the main tool used to record and submit the mandatory supervised 100 hours however there are **opportunities to improve the current physical logbook**. In particular making the process easier, not only the logging process for the learner driver but also the auditing process for the government.

A mobile app for logging supervised practice hours could provide a number of benefits when compared to the current physical logbook. An app could not only **aid in the process of accurately logging and submitting hours**, but it could also **provide feedback to the learner and Supervisor** based on practice logged and in turn, this could be used to **create structured and personalised guidance** during the Learning stage. However, careful consideration of the **issues raised create some interesting design challenges** that will need to be addressed if an app like this was to be created, such as making sure it takes into account laws and restrictions for the use of mobile devices while driving.

11.3.2 LOGBOOK APPLICATIONS FOUND AND ANALYSED

Search keywords included “learner”, “learner log”, “learner logbook”, “learner log book”, “logbook”, and “log book”.

Websites and apps	**Platform**
Learn2Go	Web
LDR - Learner Driver Recorder	iOS
L Plater	iOS
Learner Logbook QLD	iOS
Learner Logbook NSW	iOS
Learner Logbook VIC	iOS
LDROG - Learner Driver Log	iOS
Learner Log	iOS
iLog Book	iOS
LearnerBook	iOS
Teen Driving Log from Family Circle Magazine	iOS
iLearner	iOS
TimeMyDrive	iOS
DriverTimer	iOS
Learner Log Book	iOS
Learner Log Book Pro	iOS
MyLog	iOS
logNdrive Lite	iOS
DriverTimer	iOS
Learner Logbook	Android
Learner Logbook	Android
L Plate Hours (Australia)	Android
Learner Log	Android
Teach Someone To Drive (International)	Android
National Driving Academy	Android

Table 11.1 - Websites and applications reviewed

11.4 QUESTIONNAIRES USED

There were a total of five questionnaires used in the field studies.

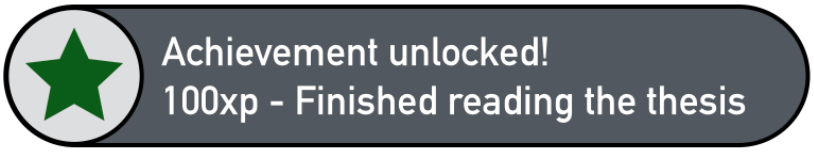
Orientation field study questionnaires include:

- A questionnaire for participants using the non-gamified version of the application
- A questionnaire for participants using the gamified version of the application

Logbook field study questionnaires include:

- A pre-study questionnaire for all participants
- A mid-study questionnaire for all participants
- A post-study questionnaire for all participants

These questionnaires can be found in their original format on the following pages.


Achievement unlocked!
100xp - Finished reading the thesis