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Designing gamified transformative and social marketing services: An investigation of serious m-games

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Purpose – The purpose of this paper is twofold: 1) to extend transformative service and social marketing practitioners’ and academics’ understanding of how gamification and serious m-games are designed, and 2) to model the effects of game design elements on key transformative service and social marketing outcomes, satisfaction, knowledge and behavioural intentions.

Design/methodology/approach – The research adopted a two-study, mixed-method research design, encompassing focus groups (n=21) and online surveys (n=497), using four current marketplace serious m-games. Study 1 was qualitative and the data were analyzed in two cycles using an inductive and deductive approach. Study 2 was quantitative and the data were analyzed using PLS-SEM.

Findings – The qualitative results of Study 1 discovered a five game design element framework for serious m-games. In Study 2, a conceptual model and hypothesized relationships were tested at a full sample level and by each serious m-game. Results show different significant relationships for each serious m-game and moderate to high levels of explanation for satisfaction and knowledge, and low to high levels of explained variance for behavioural intentions. The findings are therefore robust across four different serious m-games, but also demonstrate the nuances of the relationships.

Originality/value – This research contributes to two service research priorities: 1) leveraging technology to advance services, and 2) improving well-being through transformative services. This research demonstrates gamification through serious m-games is one form of technology that can be designed to create a satisfying and knowledge creating service experience, which can also influence intentions to perform health and well-being behaviours.

Keywords: Gamification, Serious games, Transformative service research, Social marketing, Game design elements

Article Classification: Research paper
**Introduction**

Gamification and serious games can lead to positive health and well-being outcomes (Johnson *et al*., 2016), which are key objectives of transformative service research (Anderson and Ostrom, 2015; Zheng *et al*., 2016) and social marketing (Zainuddin *et al*., 2013). It is known gamification through serious games can create value (Mulcahy *et al*., 2015) and influence motivation and knowledge for individual- (Russell-Bennett *et al*., 2016) and group-level behaviours (Yam *et al*., 2017). However, less is known about how serious games should be designed for mobile platforms, and the influence these game design elements have on key outcomes for transformative services and social marketing. This is where the current research aims to contribute to service and social marketing knowledge.

There are numerous terms for the use of gaming principles and technology for health and well-being, such as persuasive gaming (Orji *et al*., 2014) and edutainment (Rundle-Thiele *et al*., 2015). It is important to note, for the purposes of this paper, these areas of gamification are identified as serious games, as they have the common goal of being developed for broader aims than entertainment. Instead serious games are different to general games as they can be designed and used for purposes other than entertainment such as learning, behaviour change, marketing, and healthcare (Connolly *et al*., 2012; Johnson *et al*., 2016). In practice, gamification through mobile apps and games (m-games) are assisting consumers to achieve better health and well-being outcomes. For example, *Pokémon Go* was an m-game praised for encouraging players to exercise and generate friendships (Yang and Liu, 2017). Another example includes the *Nike+* app, which allows users to track and score points based upon their physical activity (Johnson *et al*., 2016). Whilst there is growing evidence in practice of gamification and m-games encouraging health and well-being behaviours, there is no existing framework in the services and social marketing literature which assists in their design or evaluation. This is important, as the design and creation of serious m-games can be expensive. Therefore, one important step in understanding how game design elements influence transformative service and social marketing outcomes is first conceptualizing a game design element framework for serious m-games.

The purpose of this paper is twofold: 1) to extend transformative service and social marketing practitioners’ and academics’ understanding of how serious m-games should be designed, and 2) to model the effects of serious m-game design elements on key transformative and social marketing service outcomes, including satisfaction, knowledge and behavioural intentions. In doing so, this paper begins to address limitations and calls for further research. For instance, while prior work evaluates serious games, the majority focus
on website-based games (Mulcahy et al., 2015; Russell-Bennett et al., 2016). This is an important limitation to address, as m-games are known to require different and more simplistic designs due to smaller screen sizes and play duration (Richardson, 2012). This research also provides new insight into service and mobile marketing research priorities. First, it provides insight into the service research priorities of technology and service provision, and how services can assist health and well-being behaviours (Ostrom et al., 2015). From a mobile marketing perspective, the study sheds light on how gamification can be used to influence desired marketing outcomes, as called for by Hofacker and colleagues (2016). It provides insights into these research priorities by empirically demonstrating how serious m-games can be one form of gamified technology designed to influence transformative service and social marketing outcomes. To achieve the aims this research investigates four serious m-games using a mixed-method, two-study research design. The main findings are robust across the two studies, but they also demonstrate the nuances of how serious m-game design elements influence key outcomes, namely satisfaction with a serious m-game, knowledge learnt by playing a serious m-game, and behavioural intentions to perform health and well-being behaviours encouraged by a serious m-game.

**Gamification, serious games, and health and well-being**

Gamification, which is the use of game design elements in non-game contexts, is gaining interest in services marketing (Harwood and Garry, 2015), transformative service research (Hamari and Koivisto, 2015), and social marketing (Mitchell et al., 2016). This is because gamification can often be preferred by consumers (Dietrich et al., 2017), but can also be effective in motivating them to perform desired tasks or actions. A current key problem in the growth of gamification for disciplines focused on health and well-being, such as transformative services and social marketing, is distinguishing the concept from others, such as persuasive technology/gaming, serious games, and personal informatics (Connolly et al., 2012; Johnson et al., 2016). However, Johnson and colleagues (2016) have attempted to address this problem by arguing gamification conceptually sits at the intersection of persuasive technology/gaming, serious games, and personal informatics. This is because all areas attempt to drive behaviours through intrinsically motivating qualities from well-designed game elements. Further support for this intersection between gamification and serious games can be seen in Xu and colleagues’ (2016) study, which examines gamification via m-games in the context of tourism marketing. It can therefore be suggested gamification and serious games are conceptually intertwined.
There is a growing body of research in the use of gamification and games for commercial marketing, transformative services, and social marketing purposes. From a commercial perspective, marketers have investigated gamification and mobile games to increase consumer engagement in services (Harwood and Garry, 2015) and tourism (Sigala, 2015; Xu et al., 2016). In transformative service-related research, studies show gamification can encourage consumers to continue reusing services (Hamari and Koivisto, 2015; Hamari, 2015), whereas social marketing studies provide evidence gamification (Mitchell et al., 2016) and serious games (Mulcahy et al., 2015; Russell-Bennett et al., 2016; Yam et al., 2017) can motivate individuals and groups to perform behaviours, such as moderate alcohol consumption, reduce household energy use, and increase physical activity. However, there is currently a lack of empirical insight into what game design elements are required for effective design of serious games, particularly those played on a mobile platform (serious m-games). A review of the literature finds the majority of gamification and serious games studies in commercial services, transformative services, and social marketing have yet to comprehensively investigate or conceptualize a game design element framework, and model its effects on desired outcomes (see Table 1). Similar gaps in understanding are also acknowledged in disciplines outside of services and social marketing, with scholars noting a lack of rigorous research and empirical evidence in examining game design elements’ impact (Johnson et al., 2017). This is particularly the case for quantitative studies, where many are critiqued for being descriptive in nature (Hamari et al., 2014). Therefore, investigating a game design element framework and its influence on transformative service and social marketing outcomes in a serious m-game context is important.

Table 1

It should be acknowledged Russell-Bennett and colleagues (2016) state they investigate game characteristics, such as game enjoyment, game knowledge, and game challenges. The current paper, however, contends rather than game characteristics, they measure game experiences, with the exception of game challenge. This is because enjoyment and knowledge are constructs empirically tested as outcomes resulting from game design elements (Johnson et al., 2016; Johnson et al., 2017). Therefore, this paper argues, whilst Russell-Bennett and colleagues (2016) contribute to knowledge relating to the usage of serious games to encourage adolescent moderate drinking on a website platform, they have
not fully captured or explained the antecedent game design elements which are required to influence such outcomes.

Other gamification and serious games studies also acknowledge the need for greater understanding of game design elements. For example, Mitchell and colleagues’ (2016) study found gamification can support behaviour change and maintenance in exercise behaviour. However, they acknowledge more research is needed to explore the manner in which game design features influence such outcomes. Furthermore, they note future research should investigate alternative models to examine gamification’s impact upon behavioural outcomes. This need for future research is also noted in the mobile marketing literature by Hofacker and colleagues (2016), who state game design elements have not been thoroughly leveraged, and whilst gamification is claimed to enhance outcomes such as customer engagement and loyalty there is limited empirical evidence of these effects. These points are supported by studies outside of marketing, such as Johnson and colleagues’ (2016) systematic review of gamification and serious games for health and well-being. Johnson and colleagues (2016) make a similar call for future research to provide a greater understanding by isolating the impacts of gamification and game design elements. Therefore, there is a need to begin to gain deeper insight into what particular game design elements are leading to positive outcomes. Serious game literature is now considered to attempt to gain this insight.

Gamification and serious game design
In the gaming literature there is little agreement as to the game design elements that are required for a serious game, and in particular those played on a mobile platform. This is due to many of the game design element frameworks overlapping each other or relabeling existing game design elements (Bedwell et al., 2012). Furthermore, it is not yet clear whether the game design elements presented in current conceptual frameworks are applicable to games played on all platforms or whether some are not required. For example, Thompson and colleagues (2008) present 23 design features for serious games targeting health behaviours. Wilson and colleagues (2009) propose seven game design elements, while Bedwell and colleagues (2012) present 20 game design elements for serious games to support learning. Another framework by Orji and colleagues (2014) presents 10 persuasive strategies, which contain similarities to game design elements, for serious games targeting health behaviours. It is evident there is little consensus on serious game design elements (Thompson et al., 2008; Wilson et al., 2009). Furthermore, there are calls for research to investigate their impact on behaviour outcomes (Orji et al., 2014). Therefore, given all serious game design elements
have yet to be applied to serious m-games, this presents further potential limitations as m-games are often different games played on dedicated game platforms due to their more simplistic design (Nitna et al., 2013) and other characteristics (see Table 2). This makes it difficult to identify a framework to assist in gaining insight into how to isolate game design elements’ influence on key outcomes. It is thus important to first understand how serious m-games are designed prior to understanding the influence game design elements have on key outcomes.

Table 2 Here

Overview of research design
In order to achieve the research aims two studies were undertaken. A summary of the studies can be seen in Table 3. In Study 1, focus groups were used to identify how serious m-games are designed, which assisted in developing a conceptual model and hypotheses. Study 2 tests the conceptual model and hypotheses using PLS-SEM. The methods and results of each study are provided next, commencing with Study 1.

Table 3 Here

Study 1
Study 1 method
Study 1 qualitatively investigated the game design elements that exist in serious m-games. Four focus groups were conducted with 23 participants, drawn from purposive sampling (also known as judgmental or selective sampling) based upon desired criteria for participants. Participant selection criteria included ownership of a smartphone, aged 18–35 years, and previously not having played any of the four games used as stimuli. The sample comprised 13 males and 10 females, who were students (n=13), employed (n=9), and unemployed (n=1). Most held a Bachelor’s degree (n=10), or completed high school (n=9), while the remainder held Master’s (n=3) or Doctorate (n=1) qualifications. The majority were single (n=18), with the remainder in either de-facto (n=4) or married relationships (n=1).

Focus group procedure
At the start of each focus group participants were asked to select one of four serious games, which they then played for 10 minutes. Following gameplay, participants engaged in a
discussion, lasting approximately one hour. A semi-structured interview guide facilitated the group discussions, allowing for a natural flow of conversation where the moderator could probe and clarify themes that emerged. All focus groups were audio recorded and transcribed verbatim.

Game stimuli
Four serious m-games were used as stimuli: *Dumb Ways to Die, Quit for You Quit for Two, My Quit Buddy,* and *CityGT.* *Dumb Ways to Die* was developed to encourage rail safety for pedestrians and drivers through scenarios played as mini-games. *Quit for You Quit for Two* encouraged smoking cessation in pregnant women (or those planning to become pregnant) via distracting activities and exercises. *My Quit Buddy* similarly assisted smoking cessation through the provision of distracting games. The four game, *CityGT* was a driving game, demonstrating the dangers of using a mobile phone whilst driving. All four serious m-games were included to overcome the limitations of prior research (Mulcahy, et al., 2015; Russell-Bennett, et al., 2016) which predominately test one game and one social or health behaviour.

*Study 1 data analysis*
Data analysis was conducted in two cycles using an inductive and deductive approach (Corbin and Strauss, 2008). In both cycles the data were coded by the primary researcher and then cross-checked by the associate researchers. In the first cycle of coding two steps were undertaken. First, the data were analyzed according to the three pre-existing game design elements identified in Table 4 using axial coding. These three game design elements were challenge, character, and feedback. After axial coding, open coding was employed to discover if any additional game design elements existed. Open coding identified two new attributes not previously identified: behavioural monitoring and virtual training. In the second cycle, game design elements which shared similar characteristics or objectives were grouped together.

*Study 1 results*
As shown in Table 4, the identified game design elements fall under one of two main categories: (1) hedonic design elements, and (2) transformative design elements.

Table 4 Here

7
**Hedonic design elements.** Hedonic design elements encompass the game design elements of challenge, feedback, and character, which are commonly found in all games. This category bears similarities to Thompson and colleagues’ (2008) entertainment components, which includes story and fun mini-games. Whilst the hedonic design elements of challenge, feedback, and character are found commonly across all games they function differently in serious m-games. Their purposes appear to be to entice players to play through entertainment, whilst also exposing them to behaviour-focused components in the game (Thompson et al., 2008). For example, challenges within the *Dumb Ways to Die* game require players to pull characters behind a yellow safety line, which is both entertaining and behaviour-focused.

**Challenge.** Challenge refers to the contests and goals within a serious m-game. Most participants reported that a level of challenge existed within their chosen game and, where an optimal 10 levels of challenge were presented, this motivated continued game usage. The data were coded further to distinguish between individual challenges and multiplayer challenges. Individual challenges allow users to compete against the game, and participants reported their desire to better previous results served as an intrinsic motivator for continued play. However, individual challenges were seen as too difficult or too easy were judged negatively:

> They’re probably good things though because then you want to beat [challenges]. You have something against your phone where you’re like, I’m going to do this and so if it lets you win the first time you would be like well that was easy and just put it down. (Respondent 8, *Dumb Ways to Die*, Female, 25 years old)

Multiplayer challenges incorporate rivalry or cooperation with friends and family playing the m-game. Most participants indicated whilst multiplayer challenges were not clearly evident in the serious m-games they played these would be just as motivating. Participants highlighted they enjoyed multiplayer challenges as this adds variety to gameplay:

> Definitely amongst friends [challenges], like even a game against my friend. I see a bit of fun in that, a bit of competitiveness to it. (Respondent 2, *Dumb Ways to Die*, Male, 25 years old)

**Feedback.** Feedback is the positive or negative reinforcement a player receives based on their actions when playing a serious m-game. Participants distinguished between two
types of feedback: positive and negative. Positive feedback manifests in the form of points, unlockable game features, or supporting and encouraging information. Participants discussed how positive feedback was an important part of their serious game, mainly owing to this giving them a sense of achievement when playing. Further, they discussed how positive feedback would motivate them to continue playing an m-game:

I don’t know maybe a couple of weeks [playing the game]. I would try and get all of those characters to pop up on the screen because they had the little message that if you get high scores you collect lots of characters. I don’t know, I’m a bit of a collector and try and get everything in it [the game]. (Respondent 10, Dumb Ways to Die, Male, 25 years old)

In contrast, negative feedback is characterized as feedback that penalizes or punishes a player for (not) performing tasks. In the case of serious m-games, negative feedback usually involves the reduction of points or “lives” within the game. Participants reported negative feedback is necessary in order to demonstrate the consequences of bad behaviour:

So you’re driving along and the phone goes off so you think instinctively to pick it up and that’s a bad thing in the game because you crash and the game ends. So I guess they are trying to teach you safe driving; don’t answer your phone whilst driving. (Respondent 9, CityGT, Male, 24 years old)

Character. Character refers to the avatars or objects within a serious m-game. Participants discussed how characters within their games varied, from anthropomorphized characters in Dumb Ways to Die, to cars in CityGT. As such, the data were coded further according to whether the characters were human or non-human. Participants discussed the emotional connection they felt to human characters and described how this relationship encouraged them to keep playing:

I really liked it that you felt like you had an emotional connection to the baby [character]. I mean I’m not even a clucky person at all. But I did feel, I don’t know, because you have to name the baby and you get to pick how it looks and make it look like you, I felt connected. (Respondent 10, Quit for You Quit for Two, Female, 24 years old)
In contrast, non-human characters were evident in *CityGT*, where a controllable car is the focal object. Participants discussed the need for greater choice and customization features of the car “character” to generate more interest in the game:

I don’t think there is a lot you can do [to change the characters/cars in the game], but if you could unlock different cars and unlocking cars at certain point levels that would add to the longevity of *CityGT*. (Respondent 23, *CityGT*, Male, 25 years old)

**Transformative design elements**

Transformative design elements encompasses two game design elements, which appear to be specific to serious games as they are related to characteristics encouraging behaviours in the real world: behaviour monitoring and virtual training. Similar to the game design elements in Thompson and colleagues’ (2008) and Orji and colleagues’ (2014) frameworks, the game design elements of behaviour monitoring and virtual training present features that focus on providing knowledge and experiences that assist users to change their behaviour.

**Behaviour monitoring.** Behaviour monitoring refers to the customized tracking of a player’s behaviour. This game design element is consistent with previous research (Orji et al., 2014). For instance, Orji and colleagues put forward self-monitoring as a persuasive strategy to assist users to track their own behaviour. In the context of this research, participants discussed how they believed behaviour monitoring to be an important game design element for serious m-games, as it provides a personalized means to track one’s behaviour. For example, in the case of the *My Quit Buddy* game, participants discussed how they would value behaviour monitoring as this would assist them in tracking the amount of money they have saved from reducing or ceasing smoking:

Yeah, so they had me enter in a bunch of information. Then they gave me personalized information so that was really good. And that would probably be the only reason I would keep it [the game], to check every week and be like how much money have I saved? Because I don’t really keep a track of that. (Respondent 5, *My Quit Buddy*, Male, 35 years old)

**Virtual training.** Virtual training refers to a serious m-game’s representation of real-world situations and behaviours. Consistent with previous research which finds enhancing realism and simulations important to game design (Lewis and Porter, 2010; Nelson et al., 2004), participants suggested virtual training was an important design element, as it provides
a means for users to observe the cause-and-effect of their behaviour in a safe virtual environment (Orji et al., 2014). For example, in the CityGT game, participants discussed how the serious m-game provided a virtual training scenario which simulated real-world behaviour. This is detailed in the following response:

I liked the fact that it did test you and didn't warn you in any way that you were going to receive a phone call and how that was incorporated into the game. I honestly thought it was someone trying to call me and I was like well I won’t answer it. (Respondent 9, CityGT, Male, 24 years old)

**Study 1 implications**

Study 1 revealed two broad categories of game design elements that potentially influence desired outcomes in transformative services and social marketing. In particular, the study conceptualizes five specific game design elements: challenge, character, feedback, behaviour monitoring, and virtual training. It is clear whilst serious m-games bare some similarities with other m-games and general games in the marketplace, additional design elements, in particular behaviour monitoring and virtual training are required in their design to encourage or assist users to perform health and well-being behaviours (see Table 5).

**Table 5 Here**

This study extends upon prior conceptualizations in the serious game literature and provides a synthesized framework of game design elements for serious games played on mobile platforms (serious m-games). The elicitation of five features contrasts with previous serious game design frameworks, which are not identified or proposed as m-game-specific. For instance, Bedwell and colleagues (2012) propose 20 game design features and Wilson and colleagues (2009) present 7. The five game design element framework of this paper reflects contemporary thinking in the m-game literature, which notes m-games require more simplistic designs due to their smaller screen size and duration of play (Richardson, 2012; Ntina et al., 2013). In synthesizing a framework of game design elements for serious m-games this study also provides insights for transformative service and social marketing practitioners as to how serious m-games are designed. However, the relative impact of these game design elements cannot be determined from this qualitative study, therefore a conceptual framework with hypotheses was developed for testing in Study 2.
**Conceptual model and hypotheses**

Consistent with the second aim of this research, a conceptual model (shown in Figure 1) was developed based upon the preliminary evidence from Study 1 and a review of the literature. For the purposes of examining game design elements’ influence on key transformative service and social marketing outcomes, the three constructs of satisfaction, knowledge and behavioural intentions will be examined. These constructs were chosen as they are theoretically relevant outcome variables to social marketing services, transformative services (Dagger et al., 2007; Sweeney et al., 2015; Russell-Bennett, et al., 2016; Zainuddin et al., 2013; Zainuddin et al., 2016), gamification and serious games (Hamari and Keronen, 2017; Lu and Wang, 2009, Wilson, et al., 2009). As noted by Williams and colleagues (2017), understanding drivers of satisfaction and behavioural intentions is still important to service research. Knowledge created by serious games relating to health and well-being behaviours is also an important construct as evidenced in studies by Russell-Bennett and colleagues (2016) and Wilson and colleagues (2009). The construct of behavioural intentions also has been shown to be an important outcome to measure the behaviours encouraged by the four serious m-games investigated in this research. For example, behavioural intentions is an important predictor for continuous smoking abstinence (Ochsner et al., 2014), which aligns with the games of *My Quit Buddy* and *Quit for You Quit for Two*. Furthermore, behavioural intentions has been shown to be important for understanding compensatory behaviour decisions for smartphone use whilst driving (e.g. limiting the length of call) (Zhou et al., 2012), which aligns with the serious m-game of *CityGT*. Behavioural intentions is also seen as an important measurement for pedestrian safety (McGhie et al., 2012), which closely aligns with the aim of the *Dumb Ways to Die* game.

**Figure 1 Here**

In this model, game design elements are posited to influence satisfaction with the serious m-game and knowledge learnt playing a serious m-game, which in turn influences an individual’s behavioural intentions to perform the behaviour encouraged by the serious m-game. For example, in the case of the *Dumb Ways to Die* game, game design elements would drive feelings of satisfaction as well as creation of new or improved knowledge relating to train safety behaviour, which in turn would influence players intentions to perform safe behaviours around trains and train stations.
The following section presents the hypotheses. It first discusses the anticipated influence of game design elements on satisfaction and knowledge, followed by a discussion of why satisfaction, and knowledge is likely to be linked with behavioural intentions.

**Challenge, characters, feedback influence on satisfaction and knowledge**

Challenge, characters, and feedback play a key role in providing an enjoyable, satisfying and knowledge creating experience for players (Fu, *et al*., 2009; Yee, 2006), including those played on a mobile platform (Xu *et al*., 2016). Support for the relationship between challenge and satisfaction can be drawn a study by Ding and colleagues (2009) found a significant relationship between challenge and satisfaction in online financial services. Characters are also an important game design element from a player perspective. This is because players become attached to their characters, which then become a source of satisfaction and enjoyment (Kim *et al*., 2012). For instance, Kim and colleagues’ (2012) study found characters within a massive multiple online role playing game were a significant predictor of game satisfaction. Feedback is also deemed to be important for improving individuals’ satisfaction. Trepte and Reinecke (2011) argue players’ evaluation of their gaming experience is based upon performance feedback. The literature also provides considerable support for challenge, character and feedback being important design considerations for games which assist learning new knowledge (Bedwell, *et al*., 2012; Fu, *et al*., 2009; Russell-Bennett, *et al*., 2016; Wilson, *et al*., 2009). Based upon the prior discussion, the following is hypothesized:

- **H1a.** Challenge will positively influence satisfaction with a serious m-game.
- **H1b** Challenge will positively influence knowledge created from a serious m-game.
- **H2a.** Character will positively influence satisfaction with a serious m-game.
- **H2b.** Character will positive influence knowledge created from a serious m-game.
- **H3a.** Feedback will positively influence satisfaction with a serious m-game.
- **H3b.** Feedback will positively influence knowledge created from a serious m-game.

**Behaviour monitoring, virtual training influence satisfaction and knowledge**

In the literature, concepts related to behaviour monitoring and virtual training have been found to be important to the design of persuasive games but have yet to be empirically tested (Orji *et al*., 2014). For example, Orji and colleagues (2014) put forward self-monitoring as an
important strategy to include in persuasive games. Other studies in gamification and serious games also hint at the importance of behaviour monitoring and virtual training for learning new knowledge. For instance, Mitchell and colleagues’ (2016) social marketing gamification study provides empirical evidence potentially behaviour tracking elements are a positive design aspect and may influence desired outcomes, such as satisfaction, knowledge and behaviour performance. Alternatively, in the serious games literature it is acknowledged games can be designed to provide virtual training scenarios which allow players to learn new skills under safe conditions (Connolly et al., 2012; Haferkamp et al., 2011). Research outside of services and gaming suggests a relationship may exist between behaviour monitoring and satisfaction, and virtual training and satisfaction (Georgellis and Lange, 2007; Schmidt, 2007; Shin and Biocca, 2017). For example, Shin and Biocca’s (2017) study found Quantified Self (QS) technology, which enables users to track their own behaviour, has an underlying link with satisfaction. Research in human resource management hints at the potential for a relationship to exist between virtual training and satisfaction (Georgellis and Lange, 2007; Schmidt, 2007). For instance, a study by Georgellis and Lange (2007) found the level of job training significantly influences employees’ job satisfaction. The current study therefore seeks to extend these past studies’ findings, hypothesizing the following:

\[ H4a. \] Behaviour monitoring will positively influence satisfaction with a serious m-game.

\[ H4b. \] Behaviour monitoring will positively influence knowledge with a serious m-game.

\[ H5a. \] Virtual training will positively influence satisfaction with a serious m-game.

\[ H5b. \] Virtual training will positively influence knowledge with a serious m-game.

**Satisfaction and knowledge influence on behavioural intentions to perform behaviour**

In contexts related and unrelated to this research, studies have shown satisfaction to directly influence behavioural intentions (Williams et al., 2017). For example, studies in transformative services (Sweeney, et al., 2015), social marketing (Zainuddin, et al., 2013) and gaming (Lu and Wang, 2008) have reported satisfaction to directly influence behavioural intentions. Consistent with past findings in serious games and social marketing, it is also predicted learnt knowledge from playing a serious m-game will influence behavioural intentions (Russell-Bennett, et al., 2016; Yam, et al., 2017). Russell-Bennett and colleagues’ (2016) findings show learnt knowledge playing a serious game can influence players self-
efficacy to perform a behaviour. Thus, based upon the prior discussion the following is hypothesized:

\[ H6a. \text{ Satisfaction with a serious m-game will positively influence behavioural intentions to perform a behaviour encouraged by the serious m-game.} \]

\[ H6b. \text{ Knowledge created by a serious m-game will positively influence behavioural intentions to perform a behaviour encouraged by the serious m-game.} \]

**Study 2**

The purpose of Study 2 was to investigate what influence game design elements had upon key outcomes, namely satisfaction, knowledge and behavioural intentions. To achieve this, a sample of 497 young adults aged 18–35 years was surveyed. The sample was sourced from an online survey panel, with the sample selection criteria being participants be aged 18–35 years and own a smartphone. Participants were sent an email with the invitation to partake in the study if they met these selection criteria. The majority of the sample was made up of respondents aged 30–33 years (33.4%), with a skew towards females (59.0%). A total of 61.6% were Apple iPhone users, whilst the remaining 38.4% were Android smartphone users. In regards to employment, 53.3% of the sample were employed full-time, 18.5% were employed part-time, 16.9% were students, and 11.3% were unemployed.

**Procedure**

An online pre-survey was employed to collect participant demographic and behavioural information (e.g. if they were a smoker or previously a smoker, if they drive a car regularly or use public transport, and if they had previously played these games). This aided in participant screening and subsequent participant allocation to a serious m-game that encouraged a relevant behaviour. Subsequently, directions to download the games were provided and participants were then asked to play their allocated game for one week. Following gameplay, participants completed a post-survey, comprising questions regarding game design elements, satisfaction with the game, and behavioural intentions towards performing the behaviours encouraged by the four games. The same four serious m-games from Study 1 were used again in Study 2 to test the robustness of the model as well as examine its generalizability and nuances across different games and social and health behaviours.

**Measurement and data analysis**
As the review of the literature revealed a lack of a single game design element measurement scale that sufficiently captures all five game design elements, multiple existing measurement scales were used for each design element. The list of items used can be seen in Appendix A. Items for challenge and feedback were drawn from Fu and colleagues’ (2009) scale, such as “I received information on my status in the game such as score or level”. The scale items for character were adapted from Hsu and colleagues’ (2009) four-item scale. For example, “I liked my baby character very much and often imagined that it could be my baby” (Quit for You Quit for Two). Given behaviour monitoring and virtual training design elements had not previously been found, items were sourced from the literature and adapted to match their conceptualization based upon the findings of Study 1. Behaviour monitoring items were adapted from Venkatesh and Davis’s (2000) usefulness scale. Items for behaviour monitoring included questions such as “Using the game improves my monitoring of my smoking” (My Quit Buddy and Quit for You Quit for Two). Virtual training questions were adapted from Lee and colleagues’ (2006) service training scale to match the serious m-game context. An example of questions for virtual training includes “I received training that enhanced my ability to stop using my phone whilst driving” (CityGT). The items for the outcomes of satisfaction and behavioural intentions were adapted from Dagger and colleagues’ (2007) scales, which have been empirically replicated in transformative service (Sweeney et al., 2015) and social marketing studies (Zainuddin et al., 2013; Zainuddin et al., 2016).

Knowledge was measured using Fu and colleagues’ (2009) previously validated scale for e-learning games. All items were measured using a five-point Likert scale, with 1=strongly disagree and 5=strongly agree. It should be noted when a game design element did not exist within the design of a serious m-game these questions were excluded from the survey. This was done to ensure questions related to the serious m-game and false data relating to a game design element were not incorporated into the data set. For example, in My Quit Buddy, characters were not a game design element incorporated in its design and questions were therefore not asked in relation to this design element. The data were then analysed using PLS-SEM in the SmartPLS 3 program using 1,000 bootstraps, which is consistent with prior service research (see Williams, et al., 2017)

Sample overview and descriptive statistics
The sample reported moderate levels of satisfaction with the games (M=3.34, SD=.99) and knowledge created by the games (M=3.11, SD=.96). The sample also had a high level of behavioural intentions to perform a health behaviour post-game play (M=3.99, SD=.82) (see
Table 5). During validity and reliability testing one item was deleted for challenge and feedback due to low factor loading scores. Convergent validity was established by observing outer loadings exceeding 0.70. The AVE scores were also above the recommended threshold of .50 (Fornell and Larcker, 1981). The AVE scores were larger than their related squared correlations, demonstrating discriminant validity. The results showed high levels of reliability with inter-item-correlation scores over .30 and Cronbach’s alpha scores over .80. Harman’s one factor test was used to check for common method bias. The one factor accounted for less than the majority of variance (39.47%). The study also conducted a common latent factor analysis as suggested by Podsakoff and colleagues (2003). The common methods factor accounted for 38.97% of the variance, less than the 0.50 threshold. The results of both tests suggest common method bias did not contaminate the results of this study.

**Table 6 Here**

**Hypotheses testing**

Table 7 and Figure 2 list the path coefficients and significant levels. At a full sample level the model collectively explained .61 of the variance in satisfaction, .61 of the variance in knowledge and .19 in behavioural intentions. The substantial R² figure suggested the data fit the model well for explaining satisfaction and knowledge, whereas the low figure for behavioural intentions suggests a weak explanation. The hypotheses tests found significant positive relationships between challenge and satisfaction (β= 0.46, p < .000), and challenge and knowledge (β= 0.11, p< .05), which support H1a and H1b. Character positively influenced satisfaction (β = 0.08, p<.05) and knowledge (β = 0.10, p < .01) supporting H2a and H2b. Feedback did not significantly influence satisfaction (β = -0.04, ns) or knowledge (β = -0.01, ns), rejecting H3a and H3b. Behaviour monitoring significantly influenced satisfaction (β = 0.20, p<.000) and knowledge (β = 0.37, p<.000) supporting H4a and H4b. Virtual training significantly influenced satisfaction (β = 0.22, p<.000) and knowledge (β= 0.35, p<.000) supporting H5a and H5b. Satisfaction positively influenced behavioural intentions (β=0.37, p<.000) supporting H6a. Knowledge did not influence behavioural intentions (β=0.08, ns), rejecting H6b. After examining the conceptual model at a full sample level the hypothesized relationships by each serious m-game were further investigated to gain deeper insight into the intricacies of these relationships.

**Table 7 & Figure 2 Here**
My Quit Buddy relationship testing. For My Quit Buddy, the conceptual model provided a high level of explanation of variance for satisfaction $R^2=.64$ and knowledge $R^2=.66$, and moderate levels for behavioural intentions $R^2=.52$. The relationship testing also uncovered significant relationships between challenge and satisfaction ($\beta=0.47$, $p<.000$), challenge and knowledge ($\beta=0.27$, $p<.000$), behaviour monitoring and satisfaction ($\beta=0.32$, $p<.01$), behaviour monitoring and knowledge ($\beta=0.38$, $p<.01$), virtual training and knowledge ($\beta=0.29$, $p<.01$), and satisfaction and behavioural intentions ($\beta=0.75$, $p<.000$).

Dumb Ways to Die relationship testing. The model explained a high level of variance for knowledge $R^2=.71$, moderate levels for satisfaction $R^2=.54$, but low levels for behavioural intentions $R^2=.16$ in the Dumb Ways to Die sample. The results show positive significant relationships between challenge and satisfaction ($\beta=0.37$, $p<.000$), character and knowledge ($\beta=0.16$, $p<.05$), behaviour monitoring and knowledge ($\beta=0.44$, $p<.000$), virtual training and satisfaction ($\beta=.21$, $p<.05$), virtual training and knowledge ($\beta=.35$, $p<.000$) and satisfaction and behavioural intentions ($\beta=0.34$, $p<.01$).

CityGT relationship testing. The model explained high levels of variance for satisfaction $R^2=.69$, moderate levels of knowledge $R^2=.60$ and low levels for behavioural intentions $R^2=.12$. The relationship testing found positive significant relationships existed between challenge and satisfaction ($\beta=0.53$, $p<.000$), challenge and knowledge ($\beta=0.25$, $p<.05$), behaviour monitoring and satisfaction ($\beta=0.29$, $p<.000$), behaviour monitoring and knowledge ($\beta=0.35$, $p<.000$), virtual training and satisfaction ($\beta=0.21$, $p<.05$), virtual training and knowledge ($\beta=0.23$, $p<.05$). Interestingly, the relationship testing also discovered a significant negative relationship between feedback and satisfaction ($\beta=-0.14$, $p<.05$). Also, unlike other serious m-games, satisfaction did not significantly drive behavioural intentions ($\beta=0.10$, ns).

Quit for You Quit for Two relationship testing. The model explained high levels of variance for satisfaction $R^2=.59$ and knowledge $R^2=.60$, but low levels for behavioural intentions $R^2=.11$. Significant positive relationships were found for challenge and satisfaction ($\beta=0.24$, $p<.05$), challenge and knowledge ($\beta=0.17$, $p<.05$), character and satisfaction ($\beta=0.20$, $p<.05$), character and knowledge ($\beta=0.23$, $p<.01$), behaviour monitoring and knowledge ($\beta=0.24$, $p<.05$), virtual training and satisfaction ($\beta=0.36$, $p<.000$), virtual training and knowledge ($\beta=0.29$, $p<.01$), satisfaction and behavioural intentions ($\beta=0.34$, $p<.05$).
Post-hoc analysis

Post-hoc analysis was also conducted after the initial hypotheses relationship testing to examine if game design elements had significant indirect effects on behavioural intentions through satisfaction, and whether significant differences existed between low-skilled and high-skilled m-game consumers within the sample. The indirect effect analysis was conducted to gain further insight into the effect of game design elements on desired outcomes as per the second aim of this paper. Whereas, variances based upon consumer skill was tested to examine if market segment differences existed.

Indirect effects. The first phase of the post-hoc analysis focused solely on the indirect effects between knowledge and behavioural intentions via satisfaction to ensure knowledge did not have a significant impact. Therefore, a new relationship path was drawn between knowledge and satisfaction for testing\(^1\). This was then carried out using the SmartPLS PLS algorithm and the bootstrap procedure which includes both the direct and indirect effect of independent variables. Indirect effects specifically examine relationships that involve a sequence of relationships with at least one intervening construct involved (Hair, et al., 2017). The results show knowledge does not have a significant indirect influence on behavioural intentions through satisfaction, with the exception of one game, *My Quit Buddy*. The analysis shows knowledge more consistently drives satisfaction alone, with this relationship being significant for three of the four games. The R\(^2\) for satisfaction within the new model with the relationship drawn between knowledge and satisfaction also slightly improved from .61 to .64 for the full sample, .64 to .65 for *My Quit Buddy sample*, .54 to .55 for *Dumb Ways to Die sample*, .69 to .74 for *CityGT*, and .59 to .66 for the *Quit for You Quit for Two*. This testing therefore confirms knowledge’s limited impact on behavioural intentions. Further, it lends support for the following direct sequence of relationships:

knowledge → satisfaction → behavioural intentions.

Table 8 Here

**Low-skilled and high-skilled consumer differences.** The second phase of the post-hoc tests aimed to examine if the relationships were significantly different between low-skilled and high-skilled m-game consumers (see Table 9). Low-skilled consumers were identified as

\(^1\) Note only the results relating to knowledge, satisfaction and behavioural intentions are reported as there were no significant differences observed in relationships tested previously.
those who responded they had little or no skill playing m-games. High-skilled consumers were identified as participants who responded they were highly skilled or skilled with playing m-games. As per Williams and colleagues (2017) and Chin (2009), the differences between these relationships were tested by computing a series of t-statistics. Interestingly, only two relationships significantly differed between low-skilled and high-skilled consumers. Specifically, the challenge to knowledge relationship differed as it was only significant for the low skilled group. Whereas, the character to satisfaction relationship was found to be significantly stronger for low-skilled consumers in comparison to high-skilled consumers.

**Table 9 Here**

*Study 2 implications*

The results of Study 2 provide empirical evidence to support game design elements’ influence on satisfaction, knowledge and behavioural intentions. This has important implications for gamification and serious game research by demonstrating the importance of including game design elements in models as they can directly drive desired transformative and social marketing outcomes, such as satisfaction, knowledge and behavioural intentions, which to date has not been empirically established. All serious m-games had game design elements which influenced satisfaction and knowledge; however, the number of game design elements and types of elements differed by game. Further, post-hoc testing examining the differences between low-skilled and high-skilled consumers found only the challenge to knowledge and character to satisfaction relationship to be significantly different. In uncovering these results and findings, this research demonstrates both the robustness of the model and the nuances of the relationships between game design elements, satisfaction, knowledge, and behavioural intentions. The differing relationships between game design elements across the four different serious m-games and the three different social and health behaviours is to be expected, as gamification research notes the inclusion and sophistication of game design elements differ significantly across different serious games as their aims often vary (Johnson *et al*., 2016). Furthermore, the consistent but also differing relationships between game design elements and satisfaction, and game design elements and knowledge bear similarities to studies in customer value, which also have been found to be subjective and difficult to generalize across different market segments and service contexts (Williams *et al*., 2017).
The results show challenge is an important hedonic game design element across all four serious m-games and could drive satisfaction and knowledge, with the minor exception of knowledge in Dumb Ways to Die. Previous research suggested challenge is an important design consideration for services (Ding et al., 2009) as well as gamification and serious games (Johnson et al., 2016; Peng et al., 2012). The findings of this study provide an important contribution to this understanding by providing further empirical evidence of the importance of challenge for successful serious m-game design.

The game design element of character was found to be a consistent driver of knowledge rather than satisfaction, with two out of the two games showing character to significantly influence knowledge, namely Dumb Ways to Die and Quit for You Quit for Two. This is consistent with previous literature, which suggests characters can be a key design element which contributes to consumers’ experiences with games (Kim et al., 2012). It also suggests characters are integral to ensuring the generation of knowledge via serious m-games. Of the three serious m-games that included characters, CityGT was the only game where character had a non-significant influence on satisfaction and knowledge. The lack of support for this relationship may suggest greater complexity in the design of this game design element is required in the current version of the CityGT game to influence satisfaction.

The results indicate feedback either insignificantly or negatively contributes to consumers’ satisfaction and knowledge. This was an interesting result, which contradicts the literature (Trepte and Reinecke, 2011) and what was hypothesized. This may be a result of poorly designed feedback features within current serious m-games. For instance, in the case of the CityGT game, focus group participants in Study 1 expressed at times they were not sure how points were allocated based upon their performance within the game. Therefore, given this lack of understanding, due to a potentially poorly designed feedback system within the serious m-game, it could be suggested this led to this design element negatively detracting from players’ satisfaction and experience with the game.

The results provide empirical evidence demonstrating the transformative design elements – behaviour monitoring and virtual training – can be strong drivers of satisfaction and knowledge. However, the results suggest behaviour monitoring is a more consistently significant driver of knowledge creation than satisfaction. This suggests players of these games may see value in serious m-games providing quantifiable information which tracks their performance of desired or undesired behaviours, which in turn assists learning knowledge about the health and well-being behaviour (Mitchell et al., 2016). The results show virtual training consistently drives both satisfaction and knowledge, with a minor
exception for virtual training and satisfaction in My Quit Buddy. This suggests virtual training is an important transformative game design element as it contributes to knowledge creation as well as an overall satisfying serious m-game experience, which in turn influences players behavioural intentions.

The results of Study 2 provide empirical evidence of the positive significant relationship between satisfaction with a serious m-game and behavioural intentions to perform a behaviour encouraged by the serious m-game. This result was found across three serious m-games except for CityGT, which suggests CityGT did not influence players behavioural intentions as it did not provide a satisfying game experience. The remaining three serious m-games which had significant relationships between satisfaction and behavioural intentions which is consistent with previous research (Dagger, et al., 2007; Hamari and Keronon, 2017; Zainuddin et al., 2013; Zainuddin et al., 2016). This study, however, sheds new perspectives on this relationship by showing satisfaction with a service, or this case a serious m-game, can influence behavioural intentions to perform an actual real-world behaviour, rather than intention to use or reuse a service as per prior research. Interestingly, whilst knowledge can be created by serious m-games (Russell-Bennett, et al., 2016; Yam, et al., 2017); learnt knowledge within a serious m-games does not consistently influence behavioural intentions across multiple serious m-games, with this relationship only being significant for the My Quit Buddy game. This may suggest the knowledge learnt by the My Quit Buddy players was more relevant or insightful regarding actions they could undertake to change their smoking behaviour. The majority of results however show knowledge is a direct influencer of satisfaction. These results do not suggest knowledge is unimportant to serious m-games influencing behaviour, however, it is a benefit or value of playing the game which assists in building a satisfying serious m-game experience. In turn, this satisfying experience influences players’ behavioural intentions to perform a health and well-being behaviour. This is consistent with the value-satisfaction-loyalty chain (Williams, et al., 2017) as well as other gamification studies (Hamari and Koivisto, 2015) which follow the sequence of directly modelling benefits (or value) onto attitudinal constructs such as satisfaction, followed by attitudinal constructs onto behavioural intentions.

Discussion
The purpose of this research was to investigate how serious m-games are designed and to model game design elements’ influence on the satisfaction with a serious m-game and
behavioural intentions to perform a behaviour encouraged by a serious m-game. Study 1 identified two categories of game design elements: hedonic, made up of challenge, character, and feedback; and transformative, made up of behaviour monitoring and virtual training. The five game design element framework presents a synthesized conceptualization in comparison to existing game design element frameworks, which can present over 20 game design elements (Bedwell et al., 2012; Thompson et al., 2008). A conceptual model with hypothesized relationships between game design elements satisfaction, knowledge and behavioural intentions, was then presented for testing. Study 2 quantitatively tested the model at a full sample and serious m-game level. The theoretical and practical implications of the research are now addressed, followed by a discussion of the limitations of the research and opportunities for future research.

**Theoretical implications**

This research contributes to two of the service research priorities (Ostrom et al., 2015): understanding service technology, and how services can assist in improving consumers’ health and well-being. This paper presents gamification and serious m-games as forms of technology which can be designed to provide a knowledge enhancing and satisfying service experience that encourages consumers’ intentions to perform health and well-being behaviours. This study is the first to begin to unpack which specific game design elements are required to influence desired outcomes namely satisfaction, knowledge and behavioural intentions from a transformative service and social marketing perspective. While the pioneering work of other studies (Mitchell et al., 2016; Mulcahy et al., 2015; Russell-Bennett et al., 2016; Yam et al., 2017; Hamari and Koivisto, 2015) suggests gamification and serious games can influence positive outcomes such as satisfaction, knowledge and behavioural intentions, their work has not provided complete insight into the game design elements required to achieve these results. By beginning to provide this insight this paper also begins to address calls by Hofacker and colleagues (2016) for greater understanding of how gamification can be used to influence desired outcomes in mobile marketing contexts. This study also begins to address current limitations in gamification and serious game research. Specifically, it begins to address the need for more rigorous insights and empirical evidence of the linkage between game design elements and health and well-being behaviours (Mitchell et al., 2016; Johnson et al., 2016). The conceptual model empirically tested in this research is robust across multiple serious m-games and behaviours. While prior studies have provided important contributions to understanding gamification (Mitchell, et al., 2016) and
serious games (Mulcahy et al., 2015; Russell-Bennett et al., 2016; Yam et al., 2017), many have studied singular games or services targeting one behaviour, in particular alcohol consumption, energy usage and exercise. By using four serious m-games which targeted three different health and well-being behaviours, this work extends the literature in gamification and serious games into behaviours yet to be thoroughly investigated in the literature. The model demonstrates how the influence of game design elements can differ across serious m-games and potentially across different health and well-being behaviours. In doing so, the cumulative results of testing four serious m-games contributes further evidence to the growing research agenda of gamification and serious games for health and well-being behaviours.

Practical implications
The results of this research have several implications for service marketers and social marketers. First, the results of this study suggest to practitioners that to design a successful and effective serious m-game, their first focus should be designing challenges and virtual training, as these game design elements were found to consistently influence satisfaction and knowledge, and satisfaction was found to be the only variable which directly influenced behavioural intentions. However, practitioners should also keep in mind to incorporate characters and behaviour monitoring to assist in learning knowledge and subsequently create a satisfying serious m-game experience. Second, this study tested four current serious m-games, and the results provide practical insights into improvements in their design. For instance, feedback is a game design element which needs to be considered by the designers of all four serious m-games, as this element is either detracting from or not contributing to a satisfying experience, as indicated by the non-significant or negatively significant relationships found in Study 2. Practitioners may also look to investigating how to improve other game design elements in such a way that they contribute to a more satisfying experience. Third, this study provides a framework which can guide the design and evaluation of gamified apps and serious m-games. This is important as service marketers and social marketers can now be more informed about the game design elements required in their gamified apps and serious m-games when engaging designers. This is important as the design of apps and m-games can be expensive. Further, the conceptual model presented in this study can potentially serve as an evaluative framework for the pre-testing of gamified apps and serious m-games. This paper suggests service marketers and social marketers may employ the
scales and conceptual model in this study to guide the development and assessment of their gamified apps and serious m-games.

Limitations and future research directions
The conceptual model presented in this research is empirically supported and robust across four serious m-games and three behaviours. However, it is acknowledged limitations should be taken into consideration when interpreting the findings and results of this research. First, this study focused on measuring consumers’ perceptions of four serious m-games. The authors agree with Russell-Bennett and colleagues (2016), direct objective measurement of game characteristics is needed to provide further insights into the design of serious games. This could be achieved via purposeful manipulation of the design of serious games examined under experimental conditions to further isolate the causality of the relationships. Whilst a strength of this research is its two-study, mixed-method research design, both studies are of a cross-sectional nature. Future research should investigate if gamification and serious games have a significant influence on health and well-being over time by employing longitudinal designs. Another limitation of this research is its focus on an Australian young adult sample and mobile platform. Future research should investigate if this study’s findings are generalizable to other market segments and to other game platforms such as console or computer. Another interesting avenue of research is to investigate if variables moderate or mediate the relationships found in this study. For example, involvement with a behaviour or the stages of change a consumer resides within may change the nature of the relationships found in this study. Finally, the explained variance of behavioural intentions was low for some of the serious m-games tested in this study; as such, incorporating additional theoretical frameworks previously used in gamification and serious games studies is suggested. These could include motivational theories such as self-determination theory (Mitchell et al., 2016), and marketing frameworks such as customer value (Mulcahy et al., 2015), which have been empirically proven to explain high levels of variance for satisfaction and behavioural intentions (Williams et al., 2017).

References


Appendix A – Scales

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Character</strong> (Hsu et al., 2009)</td>
<td></td>
</tr>
<tr>
<td>I like my character very much and I often imagined that I was the character</td>
<td>.78</td>
</tr>
<tr>
<td>I have spent much time and effort on my character</td>
<td>.71</td>
</tr>
<tr>
<td>I like to play the role of the game and to do something which I cannot achieve in my real life</td>
<td>.80</td>
</tr>
<tr>
<td>I try to create new personas and styles into my characters</td>
<td>.87</td>
</tr>
<tr>
<td><strong>Challenge</strong> (Fu et al., 2009)</td>
<td></td>
</tr>
<tr>
<td>I enjoyed the game without feeling bored or anxious</td>
<td>.69</td>
</tr>
<tr>
<td>The game provides &quot;hints&quot; that help me overcome the challenges</td>
<td>.63</td>
</tr>
<tr>
<td>The game provides video or audio features that help me overcome the challenges</td>
<td>.64</td>
</tr>
<tr>
<td>My skill gradually improved through the course of overcoming the challenges</td>
<td>.62</td>
</tr>
<tr>
<td>I was encouraged by the improvement of my skills</td>
<td>.74</td>
</tr>
<tr>
<td>The difficulty of the challenges increased as my skills improved</td>
<td>.82</td>
</tr>
<tr>
<td>The game provides new challenges with an appropriate pacing</td>
<td>.88</td>
</tr>
<tr>
<td>The game provides different levels of challenges that tailor to different players</td>
<td>.81</td>
</tr>
<tr>
<td><strong>Feedback</strong> (Fu et al., 2009)</td>
<td></td>
</tr>
<tr>
<td>I received feedback on my progress in the game</td>
<td>.79</td>
</tr>
<tr>
<td>I received immediate feedback on my actions</td>
<td>.83</td>
</tr>
<tr>
<td>I was notified of new tasks immediately</td>
<td>.71</td>
</tr>
<tr>
<td>I received information on my successes (or failures) of challenges immediately</td>
<td>.72</td>
</tr>
<tr>
<td><strong>Virtual training</strong> (Lee et al., 2006)</td>
<td></td>
</tr>
<tr>
<td>I received training that enhanced my ability to (perform behaviour)</td>
<td>.76</td>
</tr>
<tr>
<td>The game spent time and effort in simulated (behaviour) scenarios that helped me (perform behaviour)</td>
<td>.81</td>
</tr>
<tr>
<td>During the game, players had to work through activities that improved attitudes towards (behaviour)</td>
<td>.71</td>
</tr>
<tr>
<td><strong>Behaviour monitoring</strong> (Venkatesh and Davis, 2000)</td>
<td></td>
</tr>
<tr>
<td>Using the game improves my monitoring of (behaviour)</td>
<td>.92</td>
</tr>
<tr>
<td>Using the game enhances my monitoring of (behaviour)</td>
<td>.92</td>
</tr>
<tr>
<td>I find the game useful in monitoring (behaviour)</td>
<td>.90</td>
</tr>
<tr>
<td><strong>Knowledge</strong> (Fu, et al., 2009)</td>
<td></td>
</tr>
<tr>
<td>This game increased my knowledge about (behavior)</td>
<td>.85</td>
</tr>
<tr>
<td>I caught the basic ideas of the knowledge taught about (behavior)</td>
<td>.83</td>
</tr>
<tr>
<td>I tried to apply the knowledge in the game</td>
<td>.87</td>
</tr>
<tr>
<td>The game motivates the player to integrate the knowledge taught about (behavior)</td>
<td>.87</td>
</tr>
<tr>
<td>I want to know more about the facts of (behavior)</td>
<td>.76</td>
</tr>
<tr>
<td><strong>Satisfaction</strong> (Dagger, et al., 2007)</td>
<td></td>
</tr>
<tr>
<td>My feelings towards (game) are very positive</td>
<td>.94</td>
</tr>
<tr>
<td>I feel good about having played (game)</td>
<td>.93</td>
</tr>
<tr>
<td>Overall, I am satisfied with (game name) and the benefits it provides</td>
<td>.95</td>
</tr>
<tr>
<td>I feel satisfied that the results playing (game) are the best that can be achieved</td>
<td>.92</td>
</tr>
</tbody>
</table>
The extent to which playing (game) has produced the best possible outcome is satisfying.

**Behavioural intentions** (Dagger et al., 2007)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would highly recommend (behaviour) to others</td>
<td>.78</td>
</tr>
<tr>
<td>I have said positive things about (behaviour) to my family and friends</td>
<td>.68</td>
</tr>
<tr>
<td>I intend to continue (behaviour)</td>
<td>.87</td>
</tr>
<tr>
<td>I have no desire to not stop (bad behaviour)</td>
<td>.81</td>
</tr>
<tr>
<td>I intend to follow any advice given to me about (behaviour)</td>
<td>.86</td>
</tr>
</tbody>
</table>