ROCKET NINJA: NEW APPROACHES TO THE DESIGN OF DIABETIC HEALTH GAMES FOR THAI CHILDREN

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Abstract

This study investigates the factors that constitute an effective, persuasive, serious game for diabetic children. It does so by demonstrating how an understanding of Thai socio-culture shapes the Thai perspective on games and their capacity to go beyond stereotypical gaming interaction. The purpose of this study was to answer two research questions, which are: (1) What is the meaningful gamified experience for children aged five to six years old: and (2) What are the requirements of this targeted users?

To formulate a persuasive game intervention, qualitative research was used and adapted, including the use of observation, interviews, questionnaires and drawing activities. The traditions of ethnography and phenomenology were applied to understand users' game-playing motivations and users' requirements. To validate findings from fieldwork research, an iterative design process was used to test and develop the game's features and the game's functions. Two games were produced for this research as products of participatory design fieldwork, between the game designer and diabetic children. 'Rocket Ninja' is the final design prototype, which was evaluated based on the initial design feedback. Based on play testing feedback, the game provided diabetic child patients with four modes of diabetic management, namely: (1) instructional mode, (2) insulin administration mode, (3) communication mode between children and caregivers, and (4) gaming mode. The process of creating persuasive diabetes management strategies can be encapsulated in 3 themes: engagement, elucidation, and ease of use.

The findings of this research contribute to knowledge in the areas of design methodology and game design practices – whose practices represent an understanding of the effects of the surrounding context of game-playing interaction and healthcare perceptions for users of a particular age. More importantly, the model of using game-design triggers for each stage of diabetes management in young children represents design considerations for the game designer, particularly when considering the triggers that optimised clinical adherence.

Table of Contents

List of Tables

List of Illustrations

Acknowledgement

Declaration

I declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

Signed

Dated

12.08.2019

Chapter 1: Introduction
The motivating forces behind the thesis

The aim of this thesis is to explain the role of serious games as a means or method to create meaningful play experiences and games for children with type-1 diabetes in order to support the problems of coping with their conditions. As some game design experiences can appear dull for the users, this thesis aims to outline the principles for creating engaging, meaningful play experiences of serious games as a system of condition management.

This thesis presents the use of digital serious game interventions to enhance the healthcare experience of the specific demographic of young diabetic patients, and as a means to show the game design process, design considerations and user-centre design methodology. The term 'digital games' is used to represent the screen play-based approach, instead of any other types of game play, for instance, playing board games, social games with peers, and playing with physical toys. This means that designing the games in this study was finalised in the form of screen play interaction that was run on electronic devices such as mobile phones and computers. The project also examines relevant studies in psychology, healthcare perception, and game design, to help develop the research direction, methodology used, and game design procedures.

The interpretation of design for "serious games" undertaken in this project was based on three arguments. First, the thesis argues that the player's attitudes and motivation for playing digital games are shaped and influenced by social factors. Second, the concept of game user research (GUR) methodology, which was popularised in the field of game design research is adopted as a guideline to gain an understanding of the users' perceptions of the user experience in gaming (this will be discussed in chapter 5, Research Methodology). This includes the games' control, visual design, screen play interaction, sounds, and motivation architecture. Third, the thesis encapsulates the concepts identified by Drachen et al. (2018), in which the games' system is constructed from three core pillars: design, art, and programming. The main aim of this research is to expand the knowledge in the area of design, based on the researcher's experience. According to these concepts, the research structures are demonstrated through these three arguments, which will be discussed in the following chapters.

The title of this research "Rocket Ninja: New approaches to the design of diabetic health games for Thai children" denotes that it aimed to investigate the gamified techniques that serve specific targeted players, which are designed in the form of screen-based

game play. The improvement of diabetic healthcare for young children in this study referred to the improvement in coping with type 1 diabetes. The improvement in coping with the condition can be divided into three categories: the patient is able to know how to cope with his or her condition; the patient is able to focus constantly on his or her treatment regimen, such as checking the sugar levels, administering insulin, and counting carbohydrates; and the patient is able to maintain his or her adapted good behaviour after learning the coping strategies or after using the games. This study is grounded on iterative design process and game design considerations, based on users' data that reflects the facts in a specific context.

1.1 The problem

Many studies have shown that game-based approaches can be used to create strategies for health promotion, disease prevention, and self-management. This has resulted in a stronger focus on these approaches in recent years. Game-based approaches have been identified as useful tools for successfully managing of chronic conditions. However, the components and use of gamification in healthcare have to be identified to ensure increased patient engagement.

The use of persuasive technology in healthcare is not a new trend. The goal of creating such technologies is to ensure engaging experiences for the patient. Researchers such as Bandura, (1995), Thompson et al., 2010, Glaseman (2016) and Royer III (2017) have identified the benefits of using gamification to improve clinical treatment regimens for patients. The approach is built on the elements of game design theory. Using game-based elements in a healthcare management context permits patients to search for clarifications online; however, acting as your own advocate can be extremely difficult. One of the most important patient segments confronted with these issues is patients with diabetes. These patients not only have to deal with complex information, but also can struggle with regular clinical treatments. Diabetes patients also require a significant amount of care and management.

This research poses the following question: How can we create engaging game experiences for diabetic children? It has been well established that games can be used as a tool for engaging people in a task. Game-based applications have led to vast opportunities for health communication and health behaviour change. "Digital games have become successful vehicles for health promotion" (Ritterfeild and Weber, 2006). Research conducted by Queen Mary University of London in 2013 compared the effects of different games on the brain. After six to eight weeks, it was found that those who

played StarCraft for approximately an hour a day showed an improvement in memory, visual search, and information filtering abilities, as well as in other cognitive skills (Ma and Oikonomou, 2017). Additional evidence shows that using gamification as a tool for health promotion can improve patient experience and result in successful promoting health behaviour outcomes. Using serious games as a tool can help designers create effective healthcare management for children with diabetes.

1.2 Why the Thai context?

Researchers from Queen Mary University found information to support a focus on Thai patients, based on the fact that it is more common to find children with type 1 diabetes among Asian immigrants living in the United Kingdom (UK) (Hanas, 2012) than among those living in their native country. This indicates that location has an impact on the factors that lead to type 1 diabetes. Consequently, the population of children with type 1 diabetes in Thailand is shown to be lower when compared to those living in Western societies. Owing to the lower number of patients in their native country, facilities are lacking to support them, and this is particularly true for children. The database of Thai research shows that there is no regulation in place for mandating support for Thai diabetic children attending school. This finding motivated this research studying how the gamified experience can be harnessed to assist these particular users.

According to a preliminary survey for this research, information gained from Thai participants indicated that a caregiver has to visit the school to administer insulin to his or her child, as schools will not take on this responsibility. From this perspective, it is essential to implement interventions that can support Thai diabetic children and help them cope with their condition. This is further emphasised by the lack of evidence in this research area, based on Thai universities' research databases[1].

1.3 Age Composition of cohort: children of five to six years old

This project aimed to investigate the design of diabetic health games for young children based on the notion that coping and managing diabetes activities at such a young age will have to be transferred from home to school. This means that the children in this targeted age group need to be well-prepared to tackle their condition and to learn basic knowledge about living with type-1 diabetes, so that it does not affect them in school. Additionally, children who are only five or six years old will only have limited abilities

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[1] The data were collected through the online databases of several Thai universities including Chulalongkorn University, Kasetsart University, Silpakorn University and Mahidol University. The data were accessed from 2014 to 2018, which was when the preliminary stage of this research was conducted.

to perceive and tackle their condition in terms of learning how to cope with type-1 diabetes, and performing related activities such as counting carbs, insulin adjustment and balancing sugar levels (Rubin, 2008). Hence, exploring this specific age group, gifting us with new insights on how a serious games designer can deliver meaningful and persuasive diabetic health games to these targeted users, who are in the early stages of tackling their condition after being newly diagnosed with the disease.

1.4 The role of serious games in the healthcare industry

In an early work on the use of gamification tools in the workplace by Coonradt (1984), five aspects that tend to make an individual enjoy their job are outlined: clearly defined goals; better score-keeping and scorecards; frequent feedback; a higher degree of personal choice; and consistent coaching. As the concept of 'game' evolved over time, the art of rendering things game-like also evolved. Gamification has long been used as a tool for promoting performance in the workplace. The patterns of gamification vary and are dependent on different contexts, such as technological devices and social networks, among others. Today, technology has transformed gamification and serious games operations, rendering them more convenient and easier to use by those interested in doing so. In 2015, the research company Gartner forecast that in 2017, 40 per cent of companies globally would be using gamification as a core mechanism for promoting work performance. Examples are provided below to clarify the concept of play.

According to the basic definition of 'game' provided by Caillois (2001), the core aspect of a game consists of rules, and the game is governed by these rules. We play games by following these set rules. For example, in a human resource department, the applied tools of gamification will comprise the rules set as per the conventions of the company, guidance for how to work effectively, and a prize and reward as a goal. In my opinion, the notion of gamification is the process of using engaging elements found within a game to promote productive activity. This notion is similar to the idea of human-focused design, where the aim of a game is to please the player. "Human-focused design [is optimized] for human motivation in a system as opposed to [optimisation] for pure functional efficiency within the system" (Chou, 2014, p.8).

The basic principle of human-focused design is to understand human behaviour. One theory that can explain the notion of gamification is that of cognitive behavioural therapy (ABC model) developed by Beck et al. (1983), which can be described by the phrase, "as I think, so I feel and I do". In terms of behavioural science, all human behaviour can be explained by a method called the ABC analysis. In the ABC model, 'A' denotes an 'activating' event, i.e. the actual event; 'B' denotes 'belief' about the

event, i.e. this evaluation can be rational or irrational; and 'C' denotes 'consequence', i.e. the action or response that follows the belief or behaviour. The theory proposes that any action we commit is caused by a 'setting event', which is an event that can cause incidents to occur as a consequence of our actions. According to behavioural science principles, a consequence is an incentive, a stimulus for us to do and react when an antecedence has occurred or was created. Therefore, it can be said that gamification employs the ABC principle. The simplicity of gamification can easily be applied in a range of contexts; however, a game that is too simple may not be effective. For this reason, games must have complex rules and details for users to find them engaging (Beck et al., 1983).

Accordingly, this thesis adopts an emerging discipline by drawing from a wide range of existing established and non-established disciplines. It is believed here that games' mechanisms can be used as a tools for altering patient behaviour, which in turn can help to improve patients' health. A number of studies have indicated the potential of gamification for improving learning processes by creating engagement and giving rise to motivation.

Type 1 diabetes is a lifetime condition that patients have to manage themselves. The condition is not caused by poor eating habits, but is a genetic illness. It occurs when the body cannot produce insulin properly. Almost all children with diabetes have type 1 diabetes. They are born with this autoimmune disease and have to inject insulin, as their kidneys cannot produce it. It was found that when patients are newly diagnosed with type 1 diabetes, they have to learn how to cope with the condition properly; this involves three primary aspects: eating (counting carbohydrates), injecting insulin, and exercising. Coping with type 1 diabetes has to be precise and a routine has to be constantly maintained, for example, the amount of insulin intake, and the amount of carbohydrates consumed. According to the complex data involved in this study, it was found in this research that coping with type 1 diabetes can be a tedious experience for the patient.

Using digital games as a tool for promoting the care of a patient's condition is not new. Using game design mechanisms in the context of paediatric healthcare services will allow doctors and caregivers to motivate children to pay attention to their behaviour, as it relates to diabetes (Munns and Woodward, 2006; Muntean, 2011; Reiners et al., 2012; Dominguez and Saenz-de-Navarrete, 2013; Glover 2013; Wood et al., 2013). Software programs have been designed to promote an organised diabetes routine for patients. Some of these programs employ game design techniques to engage users. However, only a limited number of studies have been conducted using game design to analyse

what specifically constitutes a 'meaningful play experience', and how to create engagement to help patients manage type 1 diabetes.

There are differences in how patients might engage with a gamified experience, and this can have an influence on the game designer in terms of creating a meaningful play experience (Verpoorten et al., 2009; Ferro et al., 2013). Thus, independent behaviour can help to indicate the elements that will immerse and engage the patient within a meaningful game design experience. This is also dependent on context, for example, environment, culture, and location. In this research, the researcher investigated how a designer can create an effective and meaningful gamified experience for a patient in a Thai context, specifically, children aged five–six years suffering from type 1 diabetes.

1.5 Research goals and contributions to knowledge

The research aim was to promote a treatment regime for Thai children with type 1 diabetes through the use of games. Two main concerns addressed in this study, include: that the outcomes will enhance the quality of life of the target research group of children by providing an easier way for them to check and balance their own glucose levels; and that the knowledge gained through this study will provide new information and insights for the serious games design for the healthcare industry. To solve problems for Thai diabetic children, as part of its design process, this research had to be consistent with cross-disciplinary research methods. The aspect of healthcare perception and health psychology in Thai diabetic children's treatment had to be understood. To establish the credibility and validity of this research, it was therefore necessary to describe how the research would conducted and how answers to the research questions would obtained.

The thesis states that the concrete principles of creating a meaningful play experience in digital games is based on understanding the users' thoughts and their pattern of healthcare perception, which can offer playful experiences to the patient and lead to better maintenance of their diabetes. Moreover, the research findings help to develop the concept of serious games mechanisms and systems that can be used by children with type 1 diabetes to optimise their clinical adherence (coping with diabetes) based on the additional evidence. For example, Lieberman (1987) has shown that using gamification as a tool for health promotion can improve patient experience.

The patients' play behaviours within their particular context is analysed herein through feedback on their play experience. The result of patient (child) feedback helps in the understanding of what constitutes a meaningful play experience and allow for the determination of the factors that can effectively influence and engage patient

motivation. The goal of this research was to determine the factors that lead to a meaningful play experience and to adapt these principles to create an effective game system for promoting children's diabetes behaviour. Accordingly, the research hypothesis was that: Using a qualitative research approach, children with type 1 diabetes can enhance their motivation by applying gamification strategies to the clinical adherence system, which in turn can instil in them better behavioural changes for managing their condition.

This research aimed to contribute to knowledge related to designing a meaningful gamified experience for diabetic children aged five–six years by conceptualising gamification studies and relevant theoretical frameworks related to the area of practice. After consulting research pertaining to the contextual review of this area of knowledge, it was found that all the existing research focuses on providing information about coping strategies for children with type 1 diabetes.

As a Thai national, the researcher observed that the condition is managed better in the UK than in Thailand. In Thailand, there are few facilities dedicated to type 1 diabetes, and the services that are available are expensive. This is different from the situation in the UK, where children receive support from the National Health Service (Hanas, 2012).

In addition, the researcher's own professional experience in digital game design and user interface design is helpful for this research in that it offers an interpretation of user's requirements through the lens of the designer and delivers their expectations through real-life experience. Additionally, coming from a family with a medical background allowed for conversations with diabetic patients who were posited as the targets of this study.

To begin with, the aim of using health games is defined by each theorist differently. However, the particular game outcomes need to be more tangibly identified for this research. With reference to the problems of diabetic children, as stated in the introduction chapter, there are particular problems faced by diabetic children, such as lack of motivation to administer daily insulin doses, lack of confidence due to being different from normal children, and lack of social support due to the fewer number of patients identified in Thailand. The defining outcomes in detail would allow the game designer to explore the principles of behavioural science more easily, to support each of these nursing problems. As the theorists (Caillois, 2001;Chou, 2014: Verpoorten et al., 2009; Ferro et al., 2013) stated above, this indicates that each characteristic game element has its own goals (for example, scores, badges, and leaderboards are the

elements frequently used when designers want to urge players to feel their achievements). From this point of view, it was found that defining the problems of nursing strategies make it easier to design the game elements, in order to support each nursing strategy problem related to outlined in this study. From this point, there are four main problems that game design elements should support:

1.) Knowledge and skills: The game elements should support patients and their families in learning basic knowledge about coping strategies.

2.) Motivational tool: The game will motivate the diabetic children to follow their treatment regimen.

3.) Self-efficacy: The game will provide opportunities for patients to operate their insulin administration, count carbs, and estimate unexpected situations, and will provide immediate feedback so that patients can know the results of their activities.

4.) Lack of social support: The game will provide tools that allow the patient, parents, teachers and doctors to communicate with each other in order to support the patient's medical regimen.

The methodology chosen for this study was based on the research aims and objectives, discussed in chapter 4 (Research methodology). The objective of this research is to gain an insight into the problems with coping strategies that patients and their families experience. Furthermore, observations was made about what constitutes a meaningful gamified experience for a Thai child with diabetes aged between five and six years, and how the principles of using an engaging 'serious game' for the targeted users can be identified, particularly within a Thai context.

1.6 Research questions

To archive the purpose of this study, two research questions were formulated at the beginning of the research before designing the game:

1.) What is the meaningful gamified experience for children aged five to six in urban Thailand?

2.) What are the requirements of diabetic children aged five to six and their families?

Central to these questions are the issues of the personal, social, functional and technical context. Prior to collecting data, it was necessary to propose relevant hypotheses to clarify the focus of this research. These were that:

1) The parents of some children with type 1 diabetes are not aware of the process of their medical treatment and always require an explanation of this treatment.

2) Patients seek appropriate medical information that is easy to understand.

3) Patients seek support; they often deal with medical problems on their own and/or find help online.

1.7 Aims and objectives

The ultimate aim of this thesis is to explain the use of a serious game as a means for creating meaningful play experiences and games for children with type 1 diabetes, thereby supporting problems related to coping with their condition. The objectives of the research however were as follows:

1.) To define the issues diabetic children and their families experience when coping with type 1 diabetes in a Thai context;

2.) To investigate the persuasive game design elements and solve the diabetes-related issues with coping strategies in relation to the diabetic game design elements;

3.) To link the findings related to users' requirements and their digital experience of the diabetic health game;

4.) To analyse and reflect on the methodologies used within the research;

5.) To expand the knowledge of designing serious games to promote and improve diabetic children's coping strategies.

1.8 Research scope

This research focuses on applying game mechanics to an information and gamified system involving coping strategies for Thai children with type 1 diabetes. The design of the gamified system of information employed in this study was guided by a literature review of existing studies, behavioural science, game architecture, the capabilities of children aged five–six years, and the cultural attitudes towards general games of Thai parents and children.

To evaluate the game design system, information system research and qualitative research approaches were applied. The game system was designed using a qualitative

approach and by employing ethnography and phenomenology. This process was conducted in Bangkok, Thailand from 2015-2018. More details regarding this can be found in chapter 4 (Research methodology).

1.9 Research structure

This research is divided into the following four parts: section 1 – contextual review; section 2 – methodology and user research (data analysis); section 3 – design; section 4 – conclusion and discussion.

Chapter 2 reviews the context of the concept of serious games, the role of serious games in providing coping strategies for diabetic patients, and understanding the capabilities of children aged five–six years and Thai culture.

In chapter 3, the context of serious games for diabetes patients is explored. This chapter also investigates examples of successful games for children in Thailand during the research period (2014–2018) to investigate the motivational core drives which have been used to entertain players through the gamified mechanics.

Chapter 4 reviews the methodology used for the games system, which is divided into two paradigms: behavioural science and design science. For the behavioural science aspect, a qualitative approach was adopted as the methodology. Furthermore, details related to the data collection in this research is explained.

Chapter 5 (Users research) explains the data obtained from field research, which was conducted according to five methods based on the qualitative methodology tradition, which are observation, in-depth interview, questionnaire, focus group, and drawing activity.

Chapters 6 and 7 describe the design activities and design evaluation undertaken to formulate the games design discipline based on information obtained from fieldwork data and feedback from playtesting activities. The participants' feedback for evaluating the effects of the patient behavioural change model on their feedback during the design review will be described. Finally, chapter 8 discusses the contribution to knowledge made by this study, while the conclusion suggests potential directions for future research.

Chapter 2: Literature review

Role of serious games in coping strategies for diabetic patients

In this chapter, the relevant literature is analysed and there is discussion on the definition of persuasive diabetic games to identify the gaps and suggest a position in the area of serious game research. This chapter aims to outline the context of using serious games as a tool to promote type-1 diabetes nursing strategies by exploring the current issues concerning how a serious game can become a digital intervention to improve the experience of type-1 diabetics for specific targeted users (children ages five to six years). The current state of using a serious game approach for coping with a diabetic condition will also be investigated to promote effective persuasive key understanding, which can be applied to the game design in this study. There are five subsections to the chapter: (1) mapping the literature; (2) defining the persuasive elements of serious game architecture; (3) defining the influencing factors of meaningful game experience; and (4) the conclusion.

The first section outlines the information on the current state of serious game design studies to identify the elements that constitute the factors necessary to promote an engaging experience of serious game playing. The second section focuses on how these persuasive factors, as defined by games scholars, have been investigated in the area of game practice. The third section explores how the relevant studies have identified and intertwined the core elements of a game's mechanism into the model of patient behaviour change, to demonstrate positive health outcomes. Lastly, the fourth section illustrates the conclusions arrived at in exploring current issues in regard to engaging the constituents of serious game design factors to promote the experience of a specific patient. The understanding gained in this chapter validates existing knowledge within the area of practice to identify the possibility of expanding this, as undertaken in the later steps of this study.

2.1 Mapping the literature

It is important, at the start to determine the body of literature leading to an appropriate number of relevant studies necessary to understand the current state of serious game intervention for healthcare management.The literature studied herein was intended to evaluate, compare and explore the serious game design tools necessary for a patient to cope with the difficulties experienced.

Barajas et al. (2013) proposed a qualitative systematic literature review method, termed PICO, which is comprised of P (population), I (intervention), C (comparison) and O (outcome), and this has been commonly applied in healthcare research. The PICO method, helps to restrict the scope of the literature landscape. This research project started with the I (intervention) and P (population) dimensions, which are respectively referred to herein as the context of serious game intervention, (I) and children of the age of five to six years old in the urban area of Bangkok between the years 2014 and 2018, (P). This literature review began with serious games intervention in a healthcare management context and its current state, as well as covering content regarding users' capabilities in digital game performance in young children during the same period. The keywords used at this stage were determined while studying at the British Library (EtHos), Google scholar, and Thai library database, were: serious games, diabetic games, games for children, five-year-old child development, six-year-old child development, early age child capabilities, children's media and interaction design.

The relevant studies and publications found include three different aspects from a serious games perspective: (1) studies done through the lens of a medical specialist; (2) studies done through the lens of computer engineering and game programming; and (3) studies done through the lens of social science. There were 267 results that were discovered during this stage, published between the years 2015 and 2018. These results identified that serious games content can be comprehended through individually purposed approaches, for instance, prevention of disease, being healthy, pedagogy, coping with disabilities development, obesity, visual healthcare communication design, and educational issues and concerns.

2.2 Identifying the persuasive elements of serious game architecture

Based on exploration of the literature, data in this field of investigative research was explored, divided into four sections based on the purpose of understanding the serious game in a   healthcare context: (1) definition of serious games used for developing patient experience; (2) the constituent factors for persuasive serious health games intervention; (3) the solutions of interlacing the game's design elements into a model of patient behavioural change; and (4) the key findings of serious game studies. In the following sections these strands of literature, related to the research will be discussed.

2.2.1 Definition of 'serious games'

It was discovered that there are two meanings of a 'gamified experience' for other purposes: 'serious game' and 'gamification', both are focused on a player's pleasure. It was also found that some theorists use the phrases 'gamification' and 'serious games' in different contexts. The meanings of these two phrases seem to be close to each other in that they both define games for use in non-game contexts, rather than in providing a pleasurable experience for the players. According to the categories of 'games for health', as set out by Garell (2015), the definitions of the two terms are clearly distinguished, however, the terms 'serious games' and 'gamification' could easily be seen as ambiguous.

The term 'serious games' was coined in early 2002 by the Woodrow Wilson Centre of Scholars in Washington D.C. Their use of the term was intended to refer to games with a primary goal of educating and training players (Gee, 2004). Stokes (2005, pp. 2-6) divides the objectives of serious games into three different categories: public awareness campaigns, affecting behaviour, and empowering through game play. The conclusion here is that serious games are games which have an intended purpose other than entertainment. The format of serious games is to have the appearance of a common video game, but the serious game has more determined objectives. These days, serious games are normally developed to support a range of industries, such as education, corporate management, military and healthcare services (Cagatay et al., 2012).

Cleary and Zimmerman (2004) defines 'gamification' as a tool that uses the digitised game elements in order to engage users in the way that the designers intend. Due to the high levels of use of the terms 'serious games' and 'gamification', it is apparent that most theorists have stated that both share a similar objective, as a system of the notion of games strategies transferred into a physical intervention which relies on digital devices. There are two elements that can engage the players in gamification: transactional motivation mechanics and intrinsic motivation mechanics. The transactional motivation means the players are engaged in the game through extrinsic mechanics, like scores, badges and leader-boards, while intrinsic motivation means the players are engaged with the game due to elements of their own desires, such as autonomy, social influence and feelings of mastery. In this way, gamification focuses on the mechanics of motivation in order to create a meaningful gamified experience for the players. Pink (2009) concludes that there are three main elements of motivation constituting human behavioural change, which is the main intention for gamification strategies: autonomy, mastery and purpose. All three elements are the intrinsic motivators that motivate players to play the game. Moreover, Reynolds and Burge (2008) notes that the intrinsic motivation is the main element of the gamification that

can persuade patients. He also claims that extrinsic motivation can be used as a transactional level of motivation only, which is used to engage the player on an emotional level.

The evidence suggests that emotional levels are more concerned in the context of gamification strategies. This is in contrast to serious games, which are mainly focused on making games with both transactional motivation levels and intrinsic motivation levels. The difference between serious games and gamification strategies arising here is that the purpose of gamification is to engage players on an emotional level, rather than focusing on the game's appeal, such as interface operations, storyline design, character design and the game's magic circle (which will be defined in the next section); for their part, serious games are more concerned with game elements to immerse the players in the game sphere. Technically, serious games are more like other video games. Serious games use the traditional visual design approaches to game design and interface appearance, more than gamification strategies, which are more focused on the game elements.

The definition and architecture of gamification strategies used in serious games will be defined and explored in depth in the next section.

2.2.2 The constituent factors underpinning persuasive serious health games intervention

Structure of games architecture

For the purpose of this research, games are defined as the voluntary activity of players interacting with a system, which is defined by rules and structure. The concept of a game has been discussed several times by many leading thinkers in the past and is not within the scope of this thesis. However, there are some studies that explore the systems commonly used in game design for promoting an effective gamified experience for players. One of the principles of game systems is the MDA model, which mainly consists of three parts: mechanics, dynamics and aesthetics (Hunicke et al., 2004). The MDA is commonly studied and respected in the games design industry as a means of interpreting game architecture. Mechanics refers to the part that focuses on the structure of games, which relies on the rules in the game world. The rules can define the ability of players in the game world and constrain their choices and performance. Moreover, the rules define the modes of operation needed to achieve the goals. Dynamics refers to the way in which players interact with the game sphere, focusing on how they perform and interpret the information in the game world. Hunicke et al. (2004) support the theory that the players' action is the result of their decisions about making choices within the

game world ('magic circle'). Aesthetics represents the perception of sensory information, which includes visual, auditory and haptic feedback. According to the core concept of the MDA feedback loop, this is one perspective of serious games as a feedback loop interaction, which means that the players need to interact with the game system and the results of their operation will appear as sensory feedback to them.
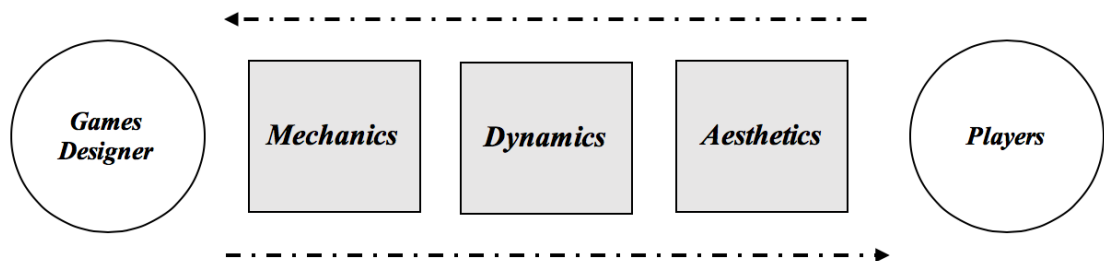
Figure 2.1 *Diagram of the MDA model (Hunicke et al., 2004)*

The MDA is a principle explaining the basic structure of game mechanics. In this stage, designers can use the MDA model as a tool to design and analyse the gamified experience in a systematic way. Moreover, the MDA model can also emphasise the concept of games as interactive systems, which form an interactive feedback loop between players and the game system. As a result, the researcher explores the concept of the 'magic circle', explaining the game-sphere interaction between players and the game world, as defined by Huizinga (1938). In his studies, Huizinga defines the key term, 'magic circle', as "a temporary world within a real world" (Anchor, 1978). The magic circle, defined as the boundary of the game world, immerses a player into its atmosphere. Some serious games immerse players through a simulated game world, allowing them to play the roles of main characters in the game world that they cannot experience in real life. For instance, the players of Grand Theft Auto (GTA), a popular action-adventure video game series, are situated in a fictional Mafia setting in America; this game was PlayStation's biggest success from 1999 to 2013. Other games, like Tetris, encourage players to compete with each other through constrained situations and rules.

In addition, Huizinga (1988) demonstrates that the magic circle can take both virtual and physical form, which can immerse players into the games within the set of rules of its world. Another aspect of game systems, apart from the MDA model presented by Hunicke et al. (2004), is a study by Salen and Zimmerman (2005), one which has become widespread in the area of game studies. As defined by them, there are three aspects of games with which designers need to be concerned: rules, play and culture. Rules refer to the set of game play criteria designed by the game designer which need to

be agreed by players before they decide to play and this consists of clear goals, sets of information and immediate feedback stating what you can and cannot do in the game sphere. Play refers to how the players interact with the game system in terms of perception of information and aesthetics in the game world. Lastly, culture is the notion of how cultural perspectives have an affect on how people live, and their perspective toward games, which can change aspects of their performance in the game context. From this point of view, for this research, this prerogative determines how culture can lead to different game play behaviours. The structure of games using the theories of Zimmerman et al. (2008) and Hunicke et al. (2004) underpinned this study, differentiating games from the perspective of players and designers. There are four main aspects used in the game structure for this research: game mechanics, interaction activities, game aesthetics and play cultures. The phrase 'game mechanics', is defined as the set of mechanics driving players to play in the game, and provides clear rules at the beginning and achievable clear goals. Interaction activities refers to the feedback provided to the users about their performance, in reaction to the game's system, from the perspective of the game's mediator. Game aesthetics refers to the game system that is concerned with transactional levels, such as: the narrative structure of storytelling, character design, scene design, and the design of a simple rewards system. Lastly, the notion of culture, in the context of targeted users, refers to an understanding of how culture influences players' attitudes. From this, game systems have enabled this research to have a better, more systematic game design, and useful tools to help design a serious game for promoting health behaviour for type 1 diabetes for this research project.
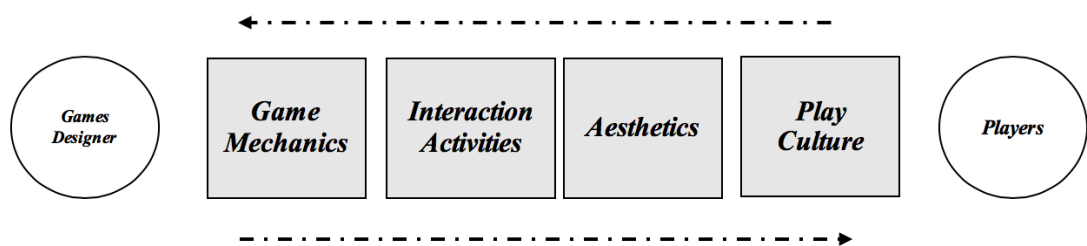
Figure 2.2 *Diagram of the games model used in this study (Klangpremjit, V., 2019)*

The identification of persuasive serious health games elements

The approach to identifying the persuasive game design trigger is laid down as the centre of the diabetic serious game design disciplines in this study. This section discusses the notion of an ideal, and an effective serious game to promote the game's objectives, explored in serious game publications. Investigating the existing research has demonstrated that the effectiveness of serious games to achieve anticipated outcomes, reveals a number of design directions which need to be applied within games for health management purposes. This study focused on relevant studies providing pragmatic knowledge, rather than a philosophical perspective, thereby allowing the application of game design principles.

The effective persuasive game elements, designed to appeal to the player were determined by identifying that the game system is assumed to maintain both intrinsic and extrinsic motivational triggers constructed in the game play experience. Studies from both Provenzo (1991) and Bowman (1982), pioneers of serious games studies, argue that extrinsic motivations, such as visual interface design, character design and action on the screen to accomplish the game's mission, are not sufficiently immersive for the players in the game sphere. In game studies, the extrinsic motivation refers to game triggers that urge players to perform a game's task through physical mechanics embedded within the game system, such as PBL systems (points, badges and leaderboards), buying virtual game equipment and the game's mode of customisation. Conversely, the intrinsic motivation aims to motivate the player through an internal physiological trigger, for instance, feeling of belonging, feeling of accomplishment and social influences. The notion of the internal and external trigger mentioned above prompts us to investigate the context of game studies as to in which way these contexts have been explored by game scholars to identify the attractive game elements.

Through the investigation of internal and external core drive, several games studies have accumulated these two disciplines into the definition of meaningful game playing factors. Two models of gaming core drives, commonly cited in serious game research and which have demonstrated their concerns regarding both the internal and external triggers as influences to a player's experience, are: Chou's core drive of player motivation (2014) and the meaningful game model by game designer Marc LeBlance (2000). Chou (2015) claimed that many successful game designs use these core drives of a player's motivation to make them feel a certain way and to encourage them to achieve their goals. However, core drives need to be selected depending on the objective of the game itself. By drawing on the concept of the core drives of motivation, Chou has been able to show that there are core drives of motivation behind gameplay, which gives designers a hint when considering the most appropriate core drive for the players in

particular circumstances. This model of player motivational core drives is called the 'Octalysis' framework, and is composed of eight core drives of motivation, which are further divided into two categories: intrinsic motivation and extrinsic motivation. In the strand of internal core drives, Chou argues that the rationale behind playing games is always driven by the intrinsic value that is designed within a game world. At this point, Chou summarises four feelings that can be sensed through the games' mechanisms, namely (1) encouraging the player's sense of belonging; (2) supporting feelings of importance; (3) delivering the feeling of being a part of society; and (4) delivering a winning mentality to the player. Meanwhile, the strand of external core drives refers to the set of game triggers that incite the player to play through the games' system triggers, namely (1) offering challenging tasks; (2) providing obstacles at each stages of gameplay; (3) giving the sense that the player is protecting something; (4) giving players unexpected and surprising situations. In contrast to Chou, Salen and Zimmerman (2004) defined the terms of core drive as play activity, in which players repeatedly perform actions over and over in order to create a large pattern of pleasure experience. Salen and Zimmerman (2004) demonstrated the motivation behind playing games in different terms from Chou's motivation core drives, as they play for pleasure (Salen and Zimmerman, 2004, p.334). This view is also supported by Hunickle., R, Leblance., N and Zubek., R (2004), as they separate the kind of pleasure players obtain from playing games into their principle regarding drives of digital game playing, which are: (1) Sensation: Game as sense pleasure[2]; (2) Fantasy: Game as make-believe[3]; (3) Narrative: Game as drama[4]; (4) Challenge[5]: Game as obstacle course; (5) Fellowship: Game as a social framework[6]; (6) Discovery: Game as uncharted territory[7]; (7) Expression: Game as self-discovery; [8]and (8) Submission: Game as pastime[9] (LeBlance,

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[2]. The game as a sensual pleasure refers to the game's triggers that give the player an immersive experience within the game's sphere – those that are driven by game's aesthetic, special effects and story-telling.

[3] Fantasy: The game as make-believe. This focuses on the game's mechanic that provides the player with a fantasy playing experiencing through a narrative that instils feelings of immersion.

[4] Narrative: The game as drama. This idea refers to the game's trigger which amplifies players' experience through the game's storyline that aims to make the player want to continue playing.

[5] Challenge: The game as an obstacle course. This concept concerns the games' triggers, which encourages the player's feelings of being the master on their games console.

[6] Fellowship: The game within a social framework. This mentions the importance of a player's community that promotes playing games motivation. This emphasises the game's triggers that can provoke a mutual relationship.

[7] Discovery: The game as uncharted territory. This concept highlights the ideas that tend to promote players' interests through exploring game world features that are both vast and secret.

[8] Expression: The game as self-discovery. This idea considers the game's system as a stage for the player to express their values through the game's features – for instance, showing an avatar, a mode of creation and making choices to change the game's world.

[9] Submission: The game as a pastime. This highlights the importance of the connection between the game's system and the player, through overall features within game's system.

2000). Overall, there seems to be some evidence to indicate that psychological terms have a role behind the playing of games.

Michele D. Dickey (2005) published a paper that demonstrated the core drives of game design to create persuasive instructional games which focused on psychological perspectives in motivation. His study concluded that in order to create persuasive instructional games, a serious games designer should be concern about the player's setting to consider the importance of how race, gender and ethnicity can influence on games design for promoting engaged learning (Dickey, 2005, pp. 67–83). These perspectives on motivation provide a hint for designers when designing game strategies and elements to support each motivational aspect. A trait perspective refers to player's motives and their needs, which depend upon the player's psychological characteristics. Examples of the most well-known motives in this perspective are 'achievement' and 'becoming a success'. A 'behaviourist learning perspective' points toward behaviour caused by our past experience, such as 'immediate feedback'. The cognitive perspective trait is defined as our motivation, as shaped by expected goals or outcomes. The perspective of self-determination refers to the perspective of motivation that relies on social context. This idea is supported by Ryan and Decci (2000), psychologists who demonstrate that people tend to have three motivations when it comes to playing games: competence (sense of efficacy), autonomy (volition and personal agency) and social relatedness (social connectedness) (p. 68). They argue that games' systems can respond to human desires in three aspects. First, a need for competence. Games have a mechanism to support the human need for competence which can be stimulated by a game's challenges, tasks and difficulties. This can be reflected through players' progress of gameplaying and positive feedback. Second, games can give a need for autonomy. In order to fulfil this desire, games offer players myriad options within the game world to be chosen, selected and explored. The game can also support players in expressing themselves freely within the game's narrative, or even create their own narratives. Finally, there is the need for relatedness, in that the game's system allows players to connect to each other. This highlights the impact of social interaction. In modern games, the features that allow the player to socialise and interact with each other are commonly represented through online playing modes becoming more successful in terms of marketing achievement.

Interest focuses on the individual interests of the player, and states that individuals' interests can motivate them further. This includes the perspective of emotion, which identifies how emotion affects player motivation – for example, the fact that players are much more motivated when they experience positive feelings (Baharom, 2014). Dickey (2005) also matched the psychological perspective to the elements of game mechanics

such as points, budgets, leaderboards, progress bars, quests, meaningful stories and avatars. This could be summarised by mentioning that the psychological perspective allows designers to demonstrate appropriate motivational triggers for specific player characteristics. When discussing users, it is essential to understand the surrounding context. Dickey (2005) concluded that there are three aspects that a designer needs to concern themselves with before designing games that immerse the targeted players within their expected narrative: naming users, identifying player context, and the context of the game world itself. Naming users adheres to the idea that before designing a game, positioning the target audience leads the designer to deliberately concern themselves with the minds and behaviours of the players, which helps the designer to address effective elements within the game. While, identifying players' context aimed to understand the context that shaped playing behaviours and performance. As a consequence, regarding young gamers in Thailand, this will underpin the understanding through the study, which will be conducted in the next section.

There are similar ideas between the core idea of LeBlance (2000), Dickey (2005) and Chou (2014), which are: (1) promoting players' sense of accomplishment through the games' mechanisms such as tasks, levels and stages; (2) delivering the features in games' system that allow players to socialise and play together; and (3) allowing the player to immerse themselves in the game world, thereby escaping their reality. As stated above, the drivers of game motivation identified by these researchers have exemplified the comprehension of persuasive game factors that can be interlaced into the expected outcome of serious game intervention through the primary focused aspects of both internal and external game design triggers.

However, while there are some similar prospects of game design elements among researchers they are not clearly distinguished in terms of the usage of internal and external drives in their disciplines (Malone, 1980; Bowman, 1982; Provenzo, 1991; Aarseth, 2001; Gartner, 2011; Bogost, 2005; Cugelmen, 2013; Buday, 2012; Gee, 2017; Linderoth, 2014). This set of principles indicates common concepts in that the most effective, persuasive games for educational purposes have the feeling of goal accomplishment (clear goal provided), being challenging, and giving immediate feedback. In addition, the development of the core drivers of the player's engagement have been divided into various directions, but do not mention the physiological motivation aspects through the set of persuasive factors that lead to meaningful of game playing. Some game scholars identify the key factors based on the game designer's perspective, suggesting design recommendations rather than focusing on the psychological motivation, which is supposed to be constructed within the game system (Gartner, 2011; Bogost, 2005; Cugelmen, 2013; Buday, 2012; Linderoth, 2014). These

categories of design principles emphasise similar concerns, stating that defining a clear goal is an imperative part of the design discipline (Gartner, 2011; Cugelmen, 2013). In addition, other game theorists have also studied the field of narratology. Pearce (2006) outlined six categories of 'narrative operators': experimental (an emergent narrative that can exist within a game); performativity (as seen by the spectators of the game); augmentary (backstory, information, context); descriptive (retelling of the game's point and progress); metastory (an overlay that creates the context for the game); and story system (a system of parts that allows players to create their own story, often seen in 'interactive narratives') (Pearce, 2006, p.145).

Additionally, Cugelmen (2013) illustrated the clear core ingredients for a satisfying outcome after playing a game, constituting goal-setting, capacity, providing feedback on a player's performance, comparing progress, social connection and play abilities. This is in line with the study by Jones et al. (1994), who summarised the main elements of providing an engaging learning experience as follows: (1) a game should engage learners through features that promote social interaction; (2) a game should contain challenging tasks for the learner; (3) the game's rules and reward system should be set up to be impartial; (4) engaging learning should be encouraged through interactions between the learner and the system (performance-based); (5) a game should provide the learner with diversified instruction and knowledge; (6) a game should encourage the learner through various strategies and triggers; (7) the learning experience should be supported by teachers as co-learners; and (8) a game should allow learner to learn through their experience of playing the game. They also emphasise that the learning progress can be developed if learner perceives the consequences of feedback as a result of their actions in the game play.

Moreover, the phrase 'game playing pleasure' has also been magnified through Gee's identification of ideal serious games for educational purposes. Gee (2007) states that pleasure is a basic element in constituting a successful learning experience and that learning ability will be enhanced if there is a problem-solving task existing in the game mechanics. Bogost (2008) supports the idea of creating problem-solving tasks and defines it with the term "examples of procedural rhetoric", which means designing a tool that allows players to practice their knowledge. Both of them highlight the idea of efficient learning processes in order to increase learning ability, as they state that the game should provide practice tasks to allow the learners to practice and take risks (Bogost, 2008). This emphasises that Gee's phrase 'games for education' as a tool to promote learning ability should be focused on the purpose of empowering the learner, making them understand knowledge and helping them solve problems (Gee, 2007).

Even though studies mainly arguing for the ideal serious game from a psychological aspect, have been shown to be less of a concern in this set of ideal serious game identification, it was found in this research that a player's pleasure lies within the intrinsic drives concept, but that the idea of that has been represented differently. It was found that the repeated psychological playing motives posited by these serious game recommendations are socially related. The idea of provoking social interaction is embedded within most of the recommendations for serious game components, mentioning the importance of being a part of society and being accepted. This has been conveyed in the assertion that players can also be engaged with the game system, via the feature of social connection, embedded within the serious games system. From previous studies, it can be seen that the findings from many game theorists and researchers (e.g., Scardamalia et al., 1989; Jones et al., 1994; Kearsley and Shneiderman, 1999) have a common, similar aspect in that the learners will be fully engaged with the game when the game provides opportunities to contact and interact with other learners.

Based on the above mentioned studies, this research suggests that immersive play experience can be enhanced through drivers which trigger individual player's motivations. There are two categories of serious games design elements explored in this section: (1) a set of design disciplines that focus on the concept of psychological portrayed in the design guidelines which intrigues a player's internal and external motives and (2) a set of design disciplines which focus on the external drive of serious games design elements from a game designer perspective.

Taking into consideration the data above provides clear game design elements for this research, which were frequently referred to and identified as the effective factors to engage a player in the game's system. This provides directions to explore the gap concerning the persuasive game factors that validate the design discipline, within the relevant area of design practice. According to the data demonstrating the identification of serious games' constituents, it was found that the aspects of game elements or external triggers and psychological triggers should be well-balanced in the next stage of this study, in order to be pragmatic for the game designer.

In terms of game architecture stated in the previous section, which is composed of four elements, it is assumed here that each of the elements play a part in the persuasive factors in both internal and external motivations. Hence, the following stage of this research aimed to fill the gap by amplifying the definition of meaningful serious game outcomes used to target a specific context. In addition, the persuasive games definition will be illustrated below, based on the game's design elements, as mentioned in Section

2.2.2 (Structure of games architecture), considered through the lens of both intrinsic and extrinsic design considerations.

Understanding player types

Rather than focusing on the game system itself, understanding the type of player is important when designing game elements (Galliers, 1992; Bartle, 2004; Marczewski, 2015). Game discourses on player types have emphasised the need to serve the appropriate game mechanics to the right type of player. This research underpins the idea of game triggers targeted to provide the player with a meaningful game playing experience, which relies on the individual player's interests. This can explain why some games engage specific players and are not attractive to others. Hence, the characteristics of player types has been studied through game scholars, to identify the appropriate set of game design triggers to the correct personal types of targeted players' characteristics.

In this section, how to define a player's characteristic type in the area of game studies has been explored, to gain an insight into the context of the study. This enhances understanding of game design directions and the techniques that game scholars have used to achieve a better understanding of players' characteristic types. The most widespread games study, investigating the categories of players type, is the multi-user dungeon (MUD-1)[10] project by Trubshaw and Bartle (1978), which categorised players into different player types. The principles were based on psychological aspects of the players' characteristics and how they preferred to play the game, in line with character theory (Sloane, 2000). According to their observations of the forum discussion, Bartle summarised the characteristics of the players and split them into four categories of player types: killer, achiever, explorer, and socialiser. Moreover, Marczewski (2015) conducted extensive research to build upon Bartle's theory and further distinguished between the types of players. He categorised players into the following groups: disruptors driven by disruption with the game system; philanthropists driven by the meaning of life; free Spirits driven by autonomy within game sphere; socialisers driven by social interaction; achievers driven by a sense of accomplishment; and players driven by the rewards system (Marczewski, 2015).

Another significant aspect frequently mentioned in game studies is the framework created by Nicole Lazzaro, the '4 keys to fun' (Lazzaro, N., 2004). She argued that the personal types of players are categorised by the purposing of game playing, divided into four stages of game difficulties: hard fun, easy fun, people fun, and serious fun. This

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[10] The 'MUD-1' (multi-user dungeon) is a role playing simulation game design project that is based on users' design research concept. The multi-player game allows player to interact, chat and fight with another players in a virtual world through JNET (British academic 2.5X network), which was set up by the University of Essex (Bartle, 2003).

stage of the game's difficulties identifies personal characteristics of the player assumed to play the games. Hard fun refers to the joy that is derived from overcoming a frustration and achieving the win-state. Thereafter, players enter the state of Fiero[11] – the feeling of triumph over adversity (Lazzaro, N., 2004). Easy fun is the fun experienced when undertaking interesting activities where we do not need to try very hard and can simply enjoy a relaxing and playful experience. This is commonly seen in games that children enjoy with their parents, such as board games and drawing. People fun is fun that one has due to interacting with other people and forming relationships. Lastly, serious fun is engaging because it has real-world impacts, such as improving oneself, making more money, or having an effect on the environment.

Investigation of these studies has exemplified the characteristic of players type definition and the games elements delivered to specific types of players. The concept arising here is to offer players a meaningful playing experience, understanding the players through a psychological lens so as to steer them with intrinsic game triggers is important in order to maintain playful experiences within the game design disciplines. The following section aims to scrutinise the contextual nature of serious games which have been studied and which have produced effective models to enhance the coping experience in dealing with disabilities or healthcare circumstances.

2.2.3. Existing solutions for interlacing a game's design elements into a model of patient behavioural change

"Behavioural science provides insight into factors that influence specific actions that can be used to guide key game design decision" (Thompson et al., 2010, p.587)

According to Thompson et al. (2010), behaviour is influenced by many factors and also demonstrates resistance to change if there are no appealing rewards. Therefore, in order to change patient behaviour, the mediator needs to be more sophisticated than simply offering direct and straightforward triggers to change behaviour. Previous studies of serious games for healthcare management report that behaviour science and motivation mechanisms are parts of the most significant factors of persuasive serious health games. Designing a set of drivers of motivation to promote self-behaviour for patients is an important element for researchers to explore in this area of practice.

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[11] 'Fiero' is an Italian word means finding satisfaction or pleasure in one's accomplishment (e.g., within the game's system). The term 'Fiero' is defined by Lazzorro (2004) as 'to identify one of the meaningful games' factors.

| VIDEO GAME
*(Entertainment
+behaviour change
component* | → | MEDIATORS
*(Intervention targets-
e.g., knowledge, skill,
self-efficacy)* | → | DESIRED
OUTCOMES
*(Behaviour change:
Physiological effects)* |
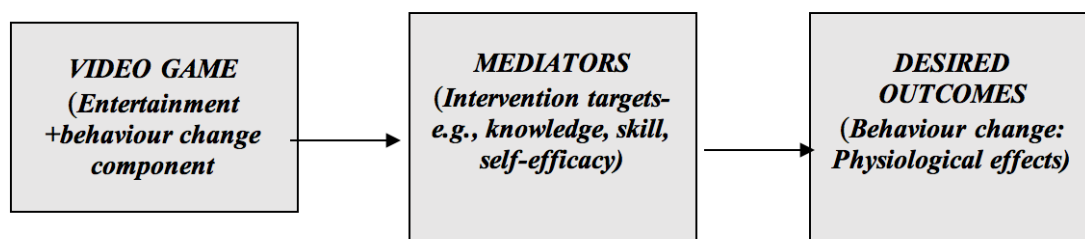
Figure 2.3 *Behaviour Change Framework illustrated by Thomson, D., Baranowski, T., and Buday, R. (2010)*

These days, there are three main purposes behind designing serious games for health-related reasons, namely (1) games as an instructional tool that assist patients with coping or nursing strategies; (2) games as a motivational tool aimed at encouraging patients to take responsibility for their own healthcare; and (3) games as a system that facilitates patients to manipulate, report on and manage their coping activities in the form of a self-organising system. Most serious games for health, as we know, tend to change and promote patient behaviour to reflect a healthier lifestyle. There are a number of studies that focus on how to use serious games as a promotional tool for health behaviour, and the principles that tend to change behaviour will be explored in this section.

Thomson , Baranowski and Buday (2010) demonstrated a "Model of Mediation of Behaviour Change" (MMBC), intending to use it in order to induce health behaviours. They used their MMBC as a conceptual framework to investigate the game interventions that could lead to improved health behaviour change. The model included three aspects: game intervention, psychosocial (mediating) variables influencing outcomes and behaviour outcomes. The game intervention dimension lies in the perspective of game elements and the game mechanics, which are posited in the MMBC model in order to change patient behaviour, which affects the psychosocial outcomes directly.

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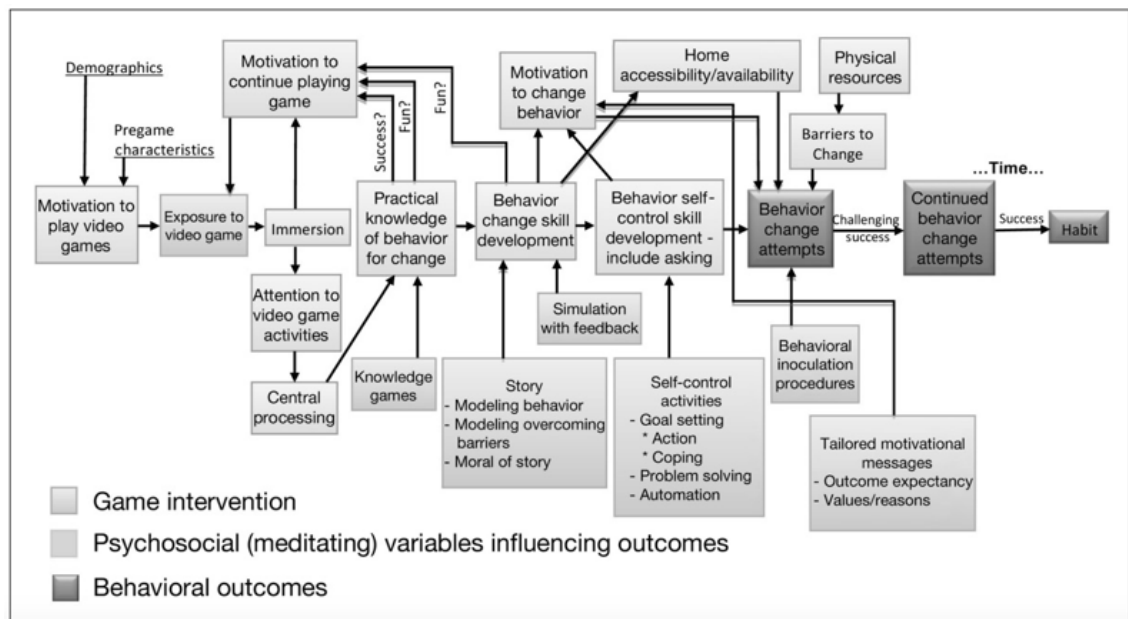
Figure 2.4 *Behaviour Change Diagram (Thomson, Baranowski and Buday, 2010, p.231)*

The aspect of 'psychosocial (mediating) variables influencing outcomes' rests in the notion of the psychology behind the players' playing and studying how players' minds work in the game sphere. Lastly, 'behaviour outcomes' indicates results from using the two previous dimensions (i.e. game intervention and psychosocial variables influencing outcomes). Here there is an opportunity to use a systematic model to apply three aspects of serious health games to the users. The mediating/moderating variable model (MMBC), based on the four main theories of behavioural psychology: self-determination theory[12], transportation theory[13], elaboration likelihood[14] and social cognitive theory.[15] Based on the four underpinning theories, Baranowski et al. (2008) illustrate the procedures that make up the model of behaviour change as follows: mastery learning principle, creating a narrative story, simulation of behaviour, goal-setting, designing difficulty levels, and tailored motivational messages (p.231).

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[12] Self-determination theory is an approach to human motivation, which concerns the motives behind people doing things based on psychological necessity. The theory is composed of three main elements, namely autonomy (the sense that people are triggered by extrinsic rewards), competence (people's needs for competence are encouraged by extrinsic rewards) and relatedness (people's motivations can be driven by the impact of the surrounding society) (Ryan and Deci, 2000).

[13] Transportation theory is aimed at demonstrating an effective, immersive narrative structure for an audience. This theory argues that the narrative transportation can be progressed by encouraging the audience to interact with the story by relating themselves to the protagonist in the storyline through their empathy and relatedness (Deighton et al., 1989).

[14] Elaboration likelihood is the theory in which it is argued that there are two routes to persuading people, namely the central route and the peripheral route. The central route to persuasion refers to when the audience is convinced by the messages' content based on logical and conscious thinking; while the peripheral route means the state in which audience is motivated by transactional appearance of the messages, such as influential people, advertising and the environment (Petty and Cacioppo, 1980).

[15] Social cognitive theory is the theory that is commonly used in the area of persuasion for educational purposes. The theory mentions that people tend to learn by observing other people's behaviour and also learning from others' actions (Bandura, 1986).

In order to encourage a patient, games should be able to deliver an achievable instructional tool that allows them to enhance their coping strategies. This highlights their arguments identifying that if a patient feels confident in what they are doing, then they will be able to more effectively manage their condition. The model argues that applying a narrative structure into a game's mechanism can immerse the patient into the game world and allow them to engage more with their treatment regimen. In addition, a game's storyline should be able to represent and simulate the way in which a patient can tackle their condition through the mechanics of the game's characteristics – for instance, recipe preparation, glucose monitoring and counting carbs. Additionally, goal-setting in games can produce supportive triggers for behavioural change in to perceive their purpose in the games setting. Designing difficulty levels is mentioned as a persuasive factor, those that are supposed to be difficult to conquer. Additionally, tailored motivational messages emphasise the concept of intrinsic motivational triggers that are aimed to be placed in the games' system. This view is supported by Malone and Lepper (1987), who demonstrate that games must employ clear goals at the beginning, provide a challenging experience, a sense of curiosity and create immersion in the game world simulation (Malone and Lepper, 1987).

Furthermore, this research also investigated the 'persuasive gamified experience' for paediatric health management, defined by Lieberman (2001), who stated that there are expected outcomes of healthcare intervention: self-concept[16], self-efficacy[17], knowledge and skills[18] and communication and social support[19]. His theory and research findings are underpinned by the findings of Bandura's , Reese and Adam's (1982) social learning theory, which indicates the impact of role-model behaviour. Bandura claims that children are influenced by characters who have a similar personality to them and remind them of themselves (Johnson and Ettema, 1986, pp.143-164). According to media theory, children are engaged by the role models seen in the media (Maibach and Parrot, 1995). Self-concept here is when the patient feels familiar with and understands their condition, and doesn't feel different from ordinary people. The Lieberman study focuses

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[16] Self-conception refers to an idea that focuses on how a games designer can resolve a patient's feeling of being different and separate from their illness through providing positive role models within games. This will encourage patients to have a better understanding of their own self-conception (Lieberman, 2001).

[17] Self-efficacy is a state in which a patient is supposed to be confident in their coping and nursing knowledge and their abilities to cope with their condition. Lieberman also suggests in her earlier research that self-efficacy when it comes to health can be amplified through features that allow players to repeatedly practice their coping and nursing activities and receive the responses (reward) based on their actions within a game (Brown et al., 1997; Lieberman., 1997)

[18] Knowledge and skills. This term is determined as patient's knowledge gain from a game which is considered as a computer based instruction. She argues that a game can provide effective knowledge for patients through reflective feedback from game prototypes and practising until the player can master it (Lieberman, 2001).

[19] Communication and social support. Lieberman claims that games can offer patients opportunities to connect with others and stimulate discussion between themselves, their friends and caregivers. This allows them to talk freely about their conditions and any anxieties connected with it (Lieberman, 2001).

on role-model engagement, based on the notion of media studies from Bandura (1982). Self-efficacy means a belief of the patient in making the decision based on the ability to perform something (Bandura, 1982). This means that people with high self-efficacy have a high ability to perform and are capable of more tasks than people with low self-efficacy. From previous theories and studies, there is some evidence to show that patients with high self-efficacy have a high ability to perform a nursing treatment regimen, which leads to a successful improvement of their health condition outcomes (Stretcher et al., 1986; Maibach and Cotton, 1995; Bandura, 1995). Knowledge and outcomes refer to outcomes in which the patient perceives and understands their condition. Lastly, communication and social support refers to circumstances in which the patient has full support from the people around them, who help them to manage their condition.

Lieberman (2001) provides a set of procedures that could lead to improved health outcomes. These include six procedures: attractive role-model characters[20], constant rehearsal of self-care[21], supportive and informative feedback[22], cumulative records of the characters[23], two-player options[24], and multi-language options[25] (Lieberman, 2001, pp.26-27). These emphasise how most serious health games use characters to persuade child patients to play the game (the aforementioned attractive role model characters). Moreover, using immediate feedback from the operation's choice of players could be a way to encourage meaningful play experience. This point is related to the statement about meaningful play experience outlined by Salen and Zimmerman (2005). Lieberman (2001) also elucidates that the game should also provide informative health feedback in order to model good behaviour choices for the patient who plays the game (Lieberman, 2001).

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[20] Attractive character role models have been mentioned as providing relativeness between games' characters and patient can promotes the effectiveness of learning abilities for the targeted patient as it represent themselves that given the idea of coping strategies (Lieberman, D., 2000).

[21] Constant reversal of healthcare refers to the triggers in which serious games are supposed to encourage child patients to continuously practice their coping and nursing strategies. This trigger will aim to enhance their abilities to cope with their condition (Lieberman, 2000).

[22] Supportive and information feedback. Lieberman suggests that delivering responsive indicators and feedback based on the patient's knowledge of coping and nursing strategies and their performance in a game can promote an effective gameplaying experience and a healthy outcome (Lieberman, 2000).

[23] Cumulative records of the characters refer to features that represent the patients' progression throughout the game and managing their heath conditions – for instance their health status, daily activities and medication taken (Lieberman, 2000).

[24] A two-player option allows enhanced communication between patients with regard to their condition (Lieberman, 2000).

[25] Languages setting can allow the child to choose their preferred language. In Lieberman's study, she designed games for children suffering from diabetes and asthma disease in both English and Spanish (Lieberman, 2001).

Debbe, Baranowski and Buday (2010) demonstrate this model based on two main theories: social cognitive theory[26] and self-determination theory[27]. They also illustrate this model as promoting self-management as it has to provide a balance between entertainment and seriousness. They (2010) also demonstrate that scientists will be more effective at encouraging behaviour change if they focus on changing the factors which could lead to behaviour change rather than focusing directly on the users' behaviour (Debbe, Baranowski and Buday, 2010). According to this notion, this model is determined to change the mediating variable in order to influence behaviour change in diabetic patients. In order to change this variable, Thompson et al. (2010) organized the principles of game design into four aspects: knowledge providing the foundation for change[28], skills enabling one to act on knowledge[29], self-efficacy[30] (confidence in a patient's ability to be successful) and motivation[31] (which determines whether behaviour will be performed) (Thompson, D., Baranowski, T., and Buday, R.,2010)

In order to influence mediating variables, there are three main types of expected outcomes in this model of study: behaviour-specific, self-regulatory and motivation. Firstly, behaviour-specific skills are skills enabling a patient to understand their diabetes condition, for example, accurately testing glucose levels, insulin administration and counting carbohydrates. Secondly, self-regulatory refers to the diabetic patient having the ability to use their skills to solve problems, which might occur during medical procedures, or employing their skills when experiencing unfamiliar circumstances. In order to gain these skills, the patient needs to gain the insight of behaviour-specific

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[26] Social cognitive theory is the theory that is commonly used in the area of persuasion for educational purposes. The theory mentions that people tend to learn by observing other people's behaviour and also absorbs their results from others' action (Bandura, A., 1986).

[27] Self-determination theory is determined to approach on human motivation in which concerns on the human motives behind doing things based on their psychological needs. The theory is composed of three main elements, which are; autonomy (the sense that people is triggered by extrinsic rewards), competence (people needs of competence are encouraged by extrinsic rewards) and relatedness (people's motivation can be driven by the impact of surrounding society) (Ryan and Deci, 2000).

[28] The first cluster within the principle of diabetic health games, as mentioned by Thompson et al. (2010) is 'knowledge providing the foundation for change'. They mentioned that providing basic information of self-coping activities includes 'what', 'when', and 'how coping performance can enhance the abilities of health management (Thompson et al., 2010).

[29] 'Skills that enable one to act on knowledge' is the key point which emphasises importance of knowledge that instructs patient to perform coping activities accurately, such as insulin administration, testing sugar levels and preparing food (Thompson et al., 2010).

[30] Self-efficacy. Thompson et al. (2010) argue that a positive response or a successful outcome within a game can promote knowledge and improve patterns of behavioural change. In addition, they also stated that other patients' behaviour regarding coping conditions can be observed to improve their self-confidence.

[31] Motivation is defined as one of the clusters that aims for a productive health outcome. In the motivation sector, this model underpins the theory of self-determination (Ryan and Deci, 2000), which includes autonomy, competence and relatedness, arguing that providing those three concepts of motivation can engage with a child within a game (Thompson et al., 2010).

knowledge. Lastly, the motivation principle in this study is based on self-determination theory, which has been discussed above in Section 2.3.2.

Moreover, Debbe, Baranowski and Buday (2010) also illustrate the game elements that can be used to support each component of the mediating variables, which will be discussed as follows. Storylines and character design are tools to influence the behaviour-specific component, while designing goal setting elements, such as rewards systems, are used to provide the support for behaviour change components. Lastly, the ability to model the characters within the game to teaches patients to cope with their condition and is a strategy used to heighten the self-efficacy component.

From this model, an interesting finding is that using serious games to influence mediating variables might lead to a more efficient model of behaviour change than just focusing on a patient's behaviour. The question then arises: do these three components of mediating variables cover all of the problems regarding nursing strategies for diabetic children? Moreover, it should be considered as to whether the game elements used for changing mediating variables stated above, including: rewards system, storyline and character design, are enough and appropriate to encourage patients to change their behaviour to a healthier regime. According to the insight gained from Section 2 (serious games architecture, p.13), there are a set of drivers of motivation which lead us to play, and each stage of game experience needs the driver of different motivations. In light of this finding, however, the model put forward by Thompson et al. (2010) seems to be vague in this context. A model of Thompson et al.'s (2010) principles were developed to support coping experienced by diabetic children in this research context, based on changing factors that could affect and enhance patient behaviour. In this research, the notion of social awareness is inserted into this model based on the information about problems with nursing strategies outlined in the introduction chapter. This research will focus more on social circumstances. As a result, the research draws conclusions regarding the model of diabetic patient behaviour change, that will be discussed in the last section of this chapter.

In view of all that has been mentioned so far, these studies outline a critical role for using gamified strategies to promote diabetes management. This provides insight into how behaviour plays a role in designing serious games to promote healthy behaviour. We can categorise these strategies into three aspects: 1) the expectation of outcomes of the game's intervention; 2) theories in use regarding the game's intervention; 3) the game elements in use within the game's intervention.

2.3 Factors influencing the user experience of meaningful serious games

There are three main subsections of key influence that constitute the effective serious game triggers lying within the key findings of serious game research: (1) cultural context, (2) age, gender and locus control and (3) model of the pattern to evaluate patient behaviour change.

2.3.1 Cultural context

"Design and culture are mutually generative of each other. Culture feeds the design process used to establish creative outcomes that in turn facilitate performances of use and meaning that shape the cultural context" (Martin, 2006, p. 261).

To provide a deep understanding of how specific geographic context has been transformed into the game design criteria, this study investigates how Thai socio-culture shapes the Thai perspective on games and their capacity to go beyond stereotypical gaming interaction. To achieve this, the findings, including primary research and secondary research data, were divided into the themes essential for Thai gamers to identify and navigate the game design, and to offer the gamified premise to the particular players. Based on the set of persuasive serious game identifications, which have been mentioned earlier, the motivational player drives that steer them to continuously play, are influenced by the surrounding context of the environment (Galliers, 1992; Bartle, 2015; Marczewski, 2015). This surrounding context can also form and define types of player and what can impact on productive game triggers for player specific characteristics. An argument arising here is that, based on the cultural influences, game players from different cultures represent their cultural play identities thorough their game playing approach performance and attitudes. This is supported by Lindtner and Dourish (2011), who state that the game's value and gaming attitudes are driven by a sociological context, such as cultural belief, economics and politics.

Not only are gaming components shaped by the cultural and social context, the patient's belief toward healthcare behaviour is also influenced by sociological factors. There are a number of studies, which demonstrate how different cultural beliefs represent differences in the way in which patients cope and respond to their health circumstances (e.g., Ali Hyder and Morrow, 2006; Cohen and Keren, 2008; Pachter, 1994). This is emphasised by Hejelm et al. (1999) through the results concerning the diabetic coping belief of patients in different cultures, which show differences of adherence to coping with a diabetic regimen. As consequence of this, the American Association of Diabetic Educators (AADE) the influencer of cultural belief on diabetes management behaviour,

demonstrate six principles for design consideration, namely: (1) each culture has its own perception; (2) understanding the barriers of gaming perception in the specific context; (3) identifying the goals that correlate with the culture's values; (4) utilising the learning diabetic information most suitable for the culture; (5) accessing the resource of caring requirements; and (6) sensitively incorporating ethnicity, race and socioeconomic status (AADE practice synopsis, 2015). In addition, understanding the cultural context and limitations of healthcare perception was also highlighted in Vaughn et al.'s (2009) research, which stated that a good game designer is expected to interpret the patient's requirements by understanding their context through co-operative research methods, those that allow targeted users to show their thoughts, attitudes and behaviours. This research proposes to gain deep insights into how Thai diabetic young children and their families represent their health beliefs in order to achieve effective diabetes coping regimen. This study claims that the external socio-cultural structure influences and constructs what is considered 'appropriate' behaviour of Thai children.

The mainstream media is mentioned in children's behaviour literature as an artefact that reflects, intermediates and emphasises their beliefs about typical 'good person' characteristics and behaviour (Brook and Hebert, 2006). Many factors influence children's behaviour. One factor which plays a strong role in children's attitudes refers to a set of beliefs, consisting of religious, philosophical and political, which can be defined as a set of mental representations (Leicester, 2008, pp. 210-239). Culturally-mediated values and the behaviour of adults influence the behaviour of children. Studies show that Thailand is a nation which is closely governed by religion. Historical records indicate that Buddhism laid down the rules to follow, and its belief has become a vital part of Thai society (Kusalasaya, 1965). The rules of Buddhism were created to enhance ethical and moral behaviour in Thai society. There are the seven basic rules in Buddhism to follow in order to be enlightened: mindfulness, investigation of the nature of reality, energy, joy or rapture, relaxation or tranquillity of both body and mind, concentration of mind and equanimity (Kusalasaya, 1965, pp.14-17). In Thailand, the role of Buddhism can easily be seen in the local area, where there is a temple in every region. Buddhist religious ceremonies play a role in every part of Thai people's lives, from when they are born to the end of life. Thus, Thai people are closely influenced by Buddhist beliefs.

The notion of 'good person' stereotypes has been emphasised through Buddhist belief and also amplified by the impact of Confucianism. The ideal of studying hard and being respectful to family members, which represents good manners, is rooted in "Confucianism", which refers to loyalty, uprightness, being good mannered and devoted to society (Reynolds, 2002). Family is one of the institutions that shapes children's

behaviour through how they are disciplined. The way in which children are disciplined relies on parental expectations, which are influenced by the ideal of the perfect self. According to the concept of collectivism which is one of the most significant characteristics of Thai culture, this concept shapes the way in which Thai parents discipline their children. The cause of discipline not only stems from the concept that based on the children may be failing to be independent, but also parent's perspective of playing digital games which is symbolic of not paying attention to studies and being deviant from the norms that demand representation of a perfect self. As a consequence of this 'perfect self' concept, along with the representation of games through the media, depictions of violence, graphical images, and its poor reputation give rise to the misbelief that a child's digital game play - from a Thai perspective - is a waste of time and money, and iconic of disobedient activity. According to this cultural understanding, there is an opportunity with this research to extend the concept of serious games as an area of educational and medical practice, seeking to erase the negative images for parents, care givers and Thai society.

2.3.2 Age
The age of the patient, especially in young children, has a significant role in their behaviour change perception due to lack of life experience. This might lead to errors of judgment in making health decisions (Rodham et al., 2009). Additionally, in the early-age child, as their body and cognition are not fully developed, their physical body and cognitive development restrict their ability to respond physically and mentally to serious health-game tasks.

This section focuses on existing serious game studies targeted at age composition of cohort: children of five to six years old, that aim to improve their experience of coping with their conditions. The research found that there is a lack of academic studies concerning the impact of users' ages on their abilities to perceive and perform gaming interaction (e.g., Lieberman, 2008; Salen and Zimmerman, 2012; Bogost, 2015). The age of the player strongly impacts on the perception of health values and game playing attitudes. Based on this discovery, this section investigates the relevance of a research area studying the capabilities of early-age children to perceive and perform healthcare behaviour change through gaming mechanisms. Diabetes' coping management tasks are differently perceived and performed by at different ages, based on task difficulties. For instance, a child aged under 10 can only perform a few of the diabetic coping responsibility tasks: (1) pricking finger with a lancet; (2) performing blood glucose level checks with a meter; (3) recognising the symptoms of unbalanced sugar levels; and (4) learning appropriate food intakes (Jarvis and Rubin, 2003). Furthermore,

children at this age can also be limited in the amount of freedom they have, due to parents' fear of hypoglycaemia. It may be difficult to give insulin and take tests when children refuse to cooperate (Hanas, 2012). The diabetic's responsibilities are identified based on the child's capabilities, in terms of both physical and mental development.

A player's age also impacts on game playing performance and the motivational game drivers. This is supported by a study by Greenberg et al. (2008) which identifies that the player's stage of development affects the type of design triggers that children find attractive to them. For instance, the study argues that children at an early age are merely intrigued by the plot and are more interested in the freely performed tasks within the game (Greenberg et al., 2008). This is also supported by Polaine (2004) in her research claiming that children of an early age tend not to explore the system and stay focused on the game's rules. Additionally, not only are the mental issues a concern in the design factors, but the child's physical development is also significant to take into consideration for a children's games media designer. Interaction system researchers have identified an effective system for game interaction for young children, to define appropriate interaction activities between a child player and the system. In this study, two aspects of a child's physical development have been considered: (1) abilities to perform physical interaction between player and system; (2) cognitive interaction between player and system.

The definition of physical abilities needed to perform game interaction in this research mainly focuses on on-screen interaction. However, serious games intervention aiming to enhance a patient's healthcare experience have been designed for myriad platforms, such as Nintendo Wii, PlayStation and mobile apps. Some platforms tend to improve the patient's conditions through physical actions, such as body movement and encouraging them to perform exercise, known as "Exergame"[32]. In this study, diabetes management regimes are posited as the main aim, which cannot be fulfilled through physical triggers, as the conditions require maintaining both constantly performing tasks and mental encouragement.

The interaction activities performed by child players have been observed within this study through three considerations concerning typing, dragging and making the physical selection on the screen. At the age of five to six years old until their body has fully developed, children have difficulty controlling things and performing interaction tasks. Such limitations of children at this age could lead to obstacles when controlling the

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[32] 'Exergames' is a combination of 'exercise' and 'games.' This identifies a type of game intending to promote physical exercise through the use of a system which applies sensor monitoring technology to track body movements (Lewis, 2009)

product, screen and targeting on a small area on the screens (Chiasson and Gutwin, 2012). General techniques used in interface design, for instance drag and drop selection, typing and many tasks on screen selections, are reported as difficulties for children at this specific age (Berkovitz, 1994; Wyeth and Purchase, 2003). Some findings suggest techniques to engage the child with the game system based on a player's capabilities (Mikhak et al., 2000; Wyeth and Purchase, 2003; Stanton et al. 2001). For instance, the idea of real stuffed toys is related to one of the techniques of a graphical interface design named 'Direct Manipulation'. Based on this context, understanding the child's capabilities to perform on-screen tasks has been considered through a further step of conducting field work to acquire an actual understanding of children with regard to these specific playing digital games abilities.

Additionally, the cognitive issues of a child's development are also represented through the studies on children's interaction. This suggests that, when designing for children at this age, designers should concern themselves with their literacy level, which may be different depending on their age. The instruction to use the interface should be in an easy and non-complicated format, a lot of text-based instruction might lead children to become confused and give up on operating the software (Steiner and Moher, 1992; Strommen,1994; Druin et al., 1999). Furthermore, Strommen (1994) found that the virtual environment could have a direct effect on the children's physical action while playing resulting from their experience of playing games. When the designer uses the technique of metaphor, children understand how to operate the interfaces quickly and expect to interact with virtual objects in the same way as they do with objects in real life (Rader, Brand and Lewis,1997).

To sum up, the player's age affects game playing performance and the belief of self-behaviour change regarding diabetic coping strategies performance. These findings can drove the research to identify more meaningful, fun experiences for children at this age by means of enhancing their entertainment perceptions through an interactive game system.

2.3.3 The underpinning theories for behaviour change model principles

Many of the previous serious games for behaviour change studies are underpinned by theories from behaviour science. In this section, the behaviour theories used for healthcare management was investigated. The criteria to select the theories that will underpin this study are based on the problems of the coping strategies of a diabetic child, as stated in the introduction. The criteria of selection for theories used are categorised into two main themes, as follows: 1) the theory has the potential to lead this research toward solutions that may solve the problems of diabetic children's

experiences; 2) the theory was previously studied in a related area of practice, which led to similar expected outcomes of health behaviour change. The table below illustrates the theories that are being applied to serious game research, and those that identify how they determine anticipated health outcomes that emerge from games' intervention based on each theory. Additionally, this also exhibits the outcomes of serious games' intervention that were targeted to present the patient's experiencing of healthcare. At this stage, the research investigates the theories of behavioural change having a concept that is relevant to the purposes of this study and being suitable for application for children with type-1 diabetes. In this part, four theories will be discussed: (1) the health belief model; (2) the trans-theoretical model (TTM); (3) self-determination theory and (4) transportation theory.

	Perspective of health outcomes	Using the game elements	Theories in used
Baranovski et al. (2011) MMVM model for children diet	- Behaviour change attempt - New habit	- Mastery learning principles story line - Simulation behaviour - Goal setting - Tailors motivate message - Behavioural inoculation procesures	- Self-Determination - Transportation theory - Elaboration likelihood - Social cognitive
Leiberman et al. (1987) Click health games model	- Knowledge - Skill-Enable - Self-Efficacy - Understanding from social supports	- Attractive model characters - Customised self-care activity - Support and informative feedback - Cumulative records of characters	- Self-Efficacy - Social learning theory - Self-Concept - Social cognitive
Michael el al. (2013) Core drives of health games	- Physcological perspective on motivation - Behaviour change attempt	- Clear goal at the beginning - Challenge experience - Providing the feeling of curiosity - Immersive the game's world simulation	- Trait perspective - Behavioural learning perspective - Cognitive perspective - Self-Determination - Perspective of interests and emotions
Thompson et al. (2010) Model of behaviour change for Diabetic child	- Knowledge provides the foundation for change - Skills enable one to act on knowledge - Self-efficacy - Motivation	- Persuasive story-line and characters design - Goals and rewards setting - Challenging interactivity - Immediate feedback	- Social cognitive - Self-Determination

Table 2.1 Table of the theories applied to design of each serious games research studied(Klangpremjit, V., 2019)

(1) Health Belief Model: The health belief model (HBM) is the principle commonly used for persuasive games for health management. The HBM is the individual-focused behaviour-purposed model that aims to understand the user's actions toward behaviour change in the area of health management. The model investigates

the rationale of not being engaged in the provision of health behaviour, as conducted by a group of American psychological (1970). The frequency of encouraging a pattern of behaviour change depends on the patient's health belief. This belief is constructed of six core elements, which are: (1) perceived susceptibility[33]; (2) perceived severity[34];(3) perceived benefit[35]; (4) perceived barrier[36]; (5) health motivation[37]; and (6) cue to action[38] (Conner and Norman, 2005). This emphasis on behaviour pattern can be productively influenced by the patient's heath perception. Even though, the HBM model is intended to be adapted to specific preventive conditions (i.e., smoking habits and dietary consuming), the model's concept urges this research to question whether the HBM model suitable for type-1 diabetes condition. If so, how can the core of this model be applied to drive the research with the structural steps of serious game planning? Additionally, this leads to another question: what is the effective belief that can motivate the patient in adoption of the behaviour change?

(2)   The transtheoretical model (TTM) is defined in terms of the premise of persuasive technologies. The transtheoretical model is one of the most significant theories about behaviour change for users. The model was demonstrated by Prochaska and DiCiemete (1983) and aimed to identify the persuasive outcomes of improving patient behaviour. They raised the argument that the patterns of a patient's behaviour are not placed and run in a logical order, which they termed as running in a spiral fashion. In addition, the theory highlights how, in actions randomly performed in an individual's interest, sometimes the patient misses a stage and sometimes revisits the stage they have missed. The theory comprises of five key elements of stage of changing: (1) pre-contemplation stage: the stage in which patient has a lack of the awareness to change to improve their behaviour; (2) contemplation stage; the stage which determines that the patient has realised the

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[33] Perceived susceptibility demonstrates the state in which a patient starts to decide whether to change their behaviour and adapt a more positive mindset or accede to the consequences of their condition (Conner and Norman, 2005).

[34] Perceived security. This concept is similar to the perceived susceptibility concept, which emphasises that if the patient realises how bad their condition could become if they do not adopt coping mechanisms, then the patient will tend to apply the model of behavioural change to avoid negative health outcomes (Conner and Norman, 2005).

[35] Perceived susceptibility is when the patient is able to know the benefits of coping with their condition. The theory mentions that if the patient sees a benefit of applying a model of behaviour change, they will tend to start adapting their behaviour (Conner and Norman, 2005).

[36] 'Perceived barriers' reflects the way in which the patients consider the cost to them if they want to apply behavioural changes (Conner and Norman, 2005).

[37] Conner and Norman identify that health motivation is valued based on individual interests, those that promote the patients to adapt the model of behaviour change for their illness (Conner and Norman, 2005).

[38] A cue to action refers to the importance of triggers that encourage behavioural changes – for example, media for healthcare awareness, and games for improving health and educational tools (Conner and Norman, 2005).

benefit of changing their behaviour; (3) preparation: this stage refers to the patient making a commitment to change their behaviour; (4) action: this is the stage where the patient engages in the new pattern of behaviour change; and (5) maintenance, the stage in which the patient can maintain this pattern of heath behaviour over time. The transtheoretical model demonstrates a set of strategies, as outlined above. We can summarise that the process in this model is underpinned by the concept of the MMVM model by Thomson et al. (2010) and Lieberman (1997). It can be concluded that there are three main processes for achieving better behaviour change: 1) knowledge process[39], 2) motivational process[40] and 3) social support process[41]. Additionally, the model was successfully intertwined into the persuasive programme of health behaviour (Bertholet et al., 2009; Siru et al., 2009; Tung et al, 2005).

(3) The theory of self-determination refers to motivation behind the actions of users without an external drive. This theory demonstrates that there are three basic psychological needs: competence, relatedness and autonomy (Deci and Ryan, 2008, pp.182-185). Competence refers to the need to be successful in performing something, which can happen by receiving positive feedback and opportunities for repetition. Relatedness refers to the need to relate to the surrounding social environment and feeling that you belong to society. Lastly, autonomy refers to the need to have choices and the ability to control our lives. The purpose of this model is to fuel people's internal drive to promote behaviour change. It was found that there is a relation between self-determination theory and the principle of gamification core drives as articulated by Chou (2014), as mentioned in Section 2 (serious games). Both of these principles focus on the motivation core drivers which can lead to user behaviour change. Self-determination theory divides the motivation drivers into three that refer to people's needs, namely autonomy, competence and relatedness, while the core drivers of gamification separate motivation drivers into eight core drivers. In order to find the answer to this question, the condition of the targeted users was investigated, and discussed in section three (understanding targeted user condition, p.34).

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[39] The knowledge process means the stage that focuses on how patients can perceive and interpret their coping strategies and use the information available to them in order to improve their health (Thompson et al., 2010).

[40] The process of motivation is defined as one of clusters that aim for productive health outcomes. In the motivational sector, this model underpins the theory of self-determination (Ryan and Deci, 2000) which includes autonomy, competence and relatedness. It can be argued that providing these three concepts of motivation can engage a child within a game (Thompson et al., 2010).

[41] The social support process is defined as the process whereby the patient will be able to change their behaviour thanks to co-operative features available within a game (Thompson et al., 2010).

(4) Narrative transportation theory focuses on how to immerse readers into the storyline or narrative (Green and Brock, 2000). This also supports the notion that children are immersed in a story because of its message. Transportation is defined as the feeling of being absorbed in the storyline, as it is used as a mechanism to persuade readers that the story can affect their beliefs. This principle is not limited to use for readers only, but also can be applied for viewers, listeners and players. Gerrig (1993) draws the conclusion that transportation is a convergence state, meaning that, in order to focus on narrative events, there are two systems operating together, which are the mental system and capacities (Malanie et al., 2000). To clarify this statement, there are three consequences of transportation theory that need to be explained. First, when readers or viewers focus on the story, they will lose the ability to perceive their real world. This is also supported by the fact that this would be occurring at the physical level; for example, when readers are immersed in a story, they might not notice the environment around them. Secondly, even though the readers realise that the story is not real, they still have strong emotions, feeling related and being motivated by the story (Gerrig, 1993).

Based on the consideration of each of the theories, this demonstrates their potential for being used in serious games intervention. This study determines the appropriate theories used for game design projects and those that are driven by the researcher's aims and objectives. At this stage of the research, the ideas that determine the concept of sociology that can be applied to persuade patients will be considered, which are: (1) the trans-theoretical model (TTM) and (2) Self-determination theory. The argument arising here is that the perspective of some of these models cannot be merely used to portray the motivational stages of young children with diabetes, such as the TTM model and HBM model. It demonstrates the idea of aiming to transform one pattern of behaviour to another, a better pattern of behaviour, rather than focusing on a lifelong condition in which the patient has no option to affect the behaviour pattern. This leads to the application for this research this model as it is more suitable in terms of structure adaptation discussed in the next stage.

According to the aforementioned theories, the research determined four main elements of games system: (1) game mechanics; (2) interaction activities; (3) aesthetics; and (4) cultural context. The four elements defined in this study will be driven by the comprehension of the literature review and fieldwork data later in this study. The above diagram reveals the specific areas of principles that tend to be interwoven into each section of a game's elements – for instance, understanding player's motives behind playing digital games, which can help the designer to formulate persuasive rules and

triggers that aim to be embedded within the game's mechanics, and the comprehension capabilities of children aged five to six that allows the designer to formulate the type of screenplay interaction that will be easy for children to understand and operate.
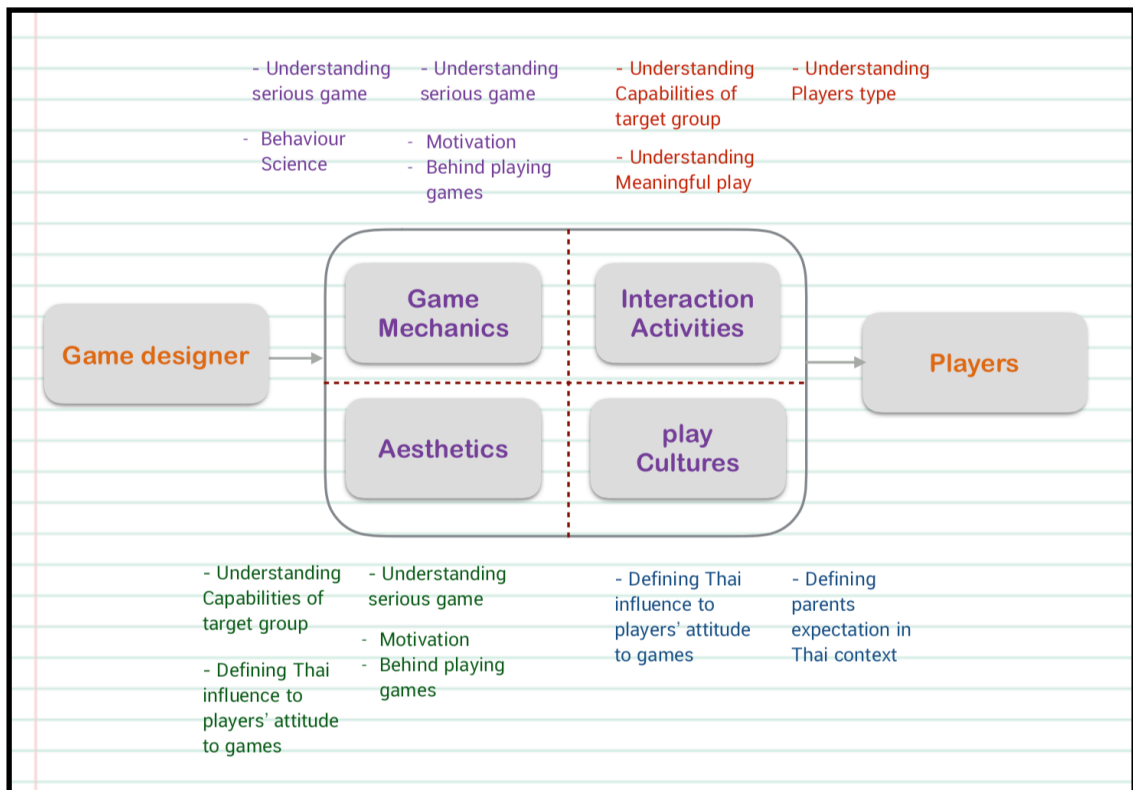
Figure 2.5 *Diagram of theories applied for each serious games research (Klangpremjit, V., 2019)*

2.4 Conclusions

This chapter has explored the context of serious games for diabetic healthcare management, helping to outline the components of productive game experiencing of the diabetes regime, which are: (1) mapping the literature; (2) identification of productive serious games experiences; and (3) the factors which influence meaningful game experiences.

PICO methods of literature review were used to examine the relevant research in the area of serious games design practice. This helps to organise the data to be synthesised at this stage, providing reliable data relevant to the area of design practice. The second section identified the structure of productive factors of serious games systems underpinned in this study. This underlines the concept that serious games are composed of four elements: the game's mechanic, interaction activity, the game's aesthetic and cultural context. There are a number of serious games studies that have identified the productive and persuasive game design factors needed to achieve the patient's

anticipated outcomes regarding health behaviour change. These persuasive indications can be separated into two terms, the game design standpoint and psychological promotional triggers standpoint. Based on this understanding, it has been posited that the position of this study is to create a balance between the psychological and game mechanisms standpoints to underpin this study. Exploring the discourses of persuasive factors for serious games intervention reveals the similarities and differences of the ideal characteristics of design disciplines. This prompts an understanding of the model of behaviour change patterns intertwined with the selected game design elements based on the relevance to the objectives of this research.

In the third section (p.31), the influence factors of productive game play were divided into three main areas, cultural context, player's age and the common underpinning theories within the area of serious games design practice. The research area of serious games for promoting health behaviours was explored to find the answers to three questions: 1) What theories do they commonly use? 2) What are the expected outcomes from their model of changing patient behaviour? 3) What does their model of changing behaviour look like? Thus, the theories employed by the previous model of behaviour change through the gamified experience were analysed and selected. The four theories were underpinned based on the following research criteria: health belief model (HBM), transtheoretical Model (TTM), self-determination theory and transportation theory. In addition, the area of research and existing games for diabetic children was investigated to determine where the gaps were in this research, which need to be stated.

Chapter 3: State of the art
Review of existing diabetes health games and the relevance of formal academic studies

This chapter investigates the context of existing diabetic game designs and the relevance of formal academic studies targeted at children with diabetes. The purpose of this chapter is to define the gap and opportunities in knowledge to be filled in the area of diabetic serious game design. Moreover, the understandings gained from this inquiry can guide research in serious game design directions, to formulate productive diabetic game outcomes. This chapter provides readers with four main sections: (1) contextual reviews; (2) review of formal academic research; (3) case studies analysis; and (4) summary of key findings.

The contextual review section demonstrates existing significant diabetic games in the diabetic healthcare industry, from early age usage of serious games to promote diabetes learning abilities, to the current state of using technologies to enhance coping with diabetes. The second section, a review of the formal academic research, explores the relevant studies that can reveal the gap and the potential to fill that gap, through academic game practice. In the case studies analysis section, the research analyses four games targeted at young children, divided into: two games to explore the entertainment functions, and two games to explore experiencing coping and managing diabetes functions. The last section identifies the key findings from studying the context of diabetic games.

3.1 Contextual reviews

As mentioned in Chapter 2 (p.25), using digital games system technology outperforms paediatric diabetic patient management in many domains. The table below demonstrates existing serious games used to promote coping with a diabetic regime representing the results of game design elements and interwoven into diabetic nursing and management activities. The achievements represented in this table also show us the leapfrogging of serious games development in terms of how the technology has been served to facilitate the game system, and the operation of diabetic management.

Existing diabetic health games for children

Game	Year of production	Game producer	Target audience Demographic population	Game details
Captain Novolin	1992	Developed by Sculpture Software and published by Raya systems for Super Nintendo	American children (6–16 years old)	This game allows the player to defeat monsters, designed as inappropriate foods such as doughnuts, cookies and milkshakes in order to teach players about food choices. The players play the role of Captain Novolin and also has to keep his sugar levels in balance. This game was the first to teach diabetic patients about the basics of balancing of sugar levels and making the correct food choices (DeShazo et al., 2010, pp.815-822).
Packy and Merlon	1994	Debra Lieberman for Super Nintendo	American children (6–12 years old)	The players play as Packy and Marlon, who are the main protagonists. In the game, Packy and Marlon have to protect a diabetic camp from an invasion of rats and mice by finding appropriate food and supplies to keep the camp safe. This game challenges the player to ensure that Packy and Marlon stay healthy and also to maintain the balance of their sugar levels through tasks such as sugar level testing, taking insulin adjustments and choosing the appropriate foods to eat. The feedback for this game was positive, as a study showed that patients with type-1 diabetes reduced their visits to hospital emergency rooms by 77% (Brown et al., 1997, pp. 77–89).
The Star Bright Life Adventure	1999	Starbright Company	American children / (the targeted were not mentioned)	The game provides a large amount of information about strategies for coping with type-2 diabetes through mini-quizzes and fast-paced mini-games. The game elements were designed to be like arcade games. This game also received very positive feedback that increased the knowledge of coping strategies (DeShazo et al., 2010, p. 822).
Dbaza's Diabetes Education for kids	2003	Dbaza Inc.	American children (6–12 years old)	This game teaches diabetic children about the management of type-2 diabetes. The game provided opportunities for players to simulate themselves in a real situation in order to rehearse how to cope with unexpected situations. 87 of the participants enjoyed playing this game and were able to increase their knowledge of coping strategies (Harris et al., 2010, pp.131–135).
Detective, Build Up Blocks & Egg Breeder	2004	Aoki et al. and Fukui T. Edutainment	Young, Japanese children (targeted ages were not mentioned)	Detective and Build Up Blocks were both designed for the Game Boy Advance console, while Egg Breeder is a computer software game. All three of these games aimed to convey basic knowledge about diabetes self-management, especially for children who have been newly diagnosed as diabetic. Detective is a simulation game that allows the player to play the role of a detective and must ensure that the detective stays healthy by balancing their sugar levels and selecting the appropriate foods. Moreover, the game also provides detective tasks in order to immerse players into the game environment rather than just focusing on the detective's condition. The game also teaches the player about the effects of unbalanced sugar levels. Build Up Blocks is a quiz game that provides a set of questions to allow the player to make appropriate food choices and how much insulin they should take (Aoki et al., 2004, pp. 855–859). Lastly, 'Egg breeders' is a virtual pet games that allows player to breed diabetic eggs. Well-balanced sugar levels and appropriate food intakes will lead to a healthy egg.
Insulot	2005	Aoki et al.	Japanese diabetic patients (12–24 years old)	The game provides information about the effect of the amount of insulin intake and carbs on sugar levels. The game's content was designed as a slot machine system to teach the player how to adjust insulin intake in order to keep their blood sugar levels in the normal range (Aoki et al., 2005, p. 760).

Existing diabetic health games for children				
Bayer Diget	2011	The pharmaceutical company Bayer in collaboration with Nintendo	Young, British children (targeted ages were not mentioned)	Bayer Diget was aimed at helping diabetic children monitor their sugar levels, which allowed them to gain rewards and unlock mini-games when their sugar levels were correctly balanced. Moreover, it also functions as a standalone blood glucose monitor. When the player connects Bayer Diget to the Game Boy Advance console, the game translates blood test results into a score and provides rewards. The game's purpose is to help the patient enhance their experience of maintaining a healthy glucose balance. Moreover, the player can also connect their avatar to an online community to display their avatar's abilities and can allow them to compete with other diabetic children through a leaderboard system (Klingensmith et al., 2012)
Monster Manner	2013	Ayogo, and Diabetes UK	British children / (the targeted were not mentioned)	Monster Manor is a diabetes health games intended to promote sugar levels management for early-age diabetic patients. The game is integrated with an auto-connected blood glucose monitor with a mobile device application. This technology promotes ease of use for the diabetic user to upload their sugar levels into the game's information system. Additionally, the player is engaged with the games' mechanisms through a reward systems model (point, badges and leader boards) in which the player will earn rewards based on their sugar levels
MySugr	2016	mySugr, Vienna	Children (the targeted were not mentioned)	MySugr Junior is a diabetes management application for mobile devices applying a virtual pet game strategy to encourage early-age diabetic children to constantly manage their treatment regimen. The game encourages young diabetic players to record and manage his or her sugar levels through the game's rewards mechanism. This rewards system is represented through unlocking features and promoting the virtual pet's well-being.
Diabetic Mario	2016	Baghaei, et al.	6–13 year-old children living in Auckland, New Zealand	This is a diabetic health game that is adapted from the well-known game Mario Brothers. The Mario Brothers game provides a free modifiable game code that can be downloaded by game designers. The game allows the player to balance sugar levels in order to rescue the princess. In the game, players also have to avoid hitting inappropriate food choices, which will reduce the score that was represented as sugar levels positioned in the top corner of the screen.

Table 3.1 Existing diabetic health games for children (Klangpremjit, V., 2019)

Advances in serious game production are now developing so rapidly that it is impossible to review them all in this section, but mentioning a sample will provide an idea of the breath of application and design techniques applied in the game design system within this study. Exploring existing games in the diabetic games industry allows for the determination of the platforms which have been used to enhance game play experience. The table above illustrates the development of technologies that have been used since the first diabetic game which took the form of computer software, Captain Novolin (1992), to the recent game interventions in the form of mobile

applications, or even interlacing the game with medical equipment, like Bayer Diget (2011). This indicates the evaluation of technological adaptations to promote good game experiences for diabetic patients, including making the visualisation of serious games more appealing to child users, moving from 32 bits pixel to close to high definition, realistic visual images for game interfaces. Not only has the technology of games intervention in diabetic game design and development made huge advances, but the game content through the years has also vastly improved.

There are three dimensions that have emerged and improved from existing games, shown in Table 3.1: (1) the platform used; (2) the development of diabetic games' content; and (3) the techniques that have adapted through the game systems. Firstly, the game platforms evaluated made great progress in development of game console technology, indicating how the technology has provided players with greater convenience to be able to play at any time, with easier access, compatibility and accuracy. For instance, diabetic games platforms have moved from the awkward sized game consoles to compact platforms on a mobile device. This illustrates that, previously diabetic patients experienced lack of opportunities to use serious game interventions to enhance their diabetic coping regime, whereas today's patients have a better chance to access these coping strategies-focused games. The development of diabetic games has helped, not only to support the patient, but also their associated caregivers to cope with a type-1 diabetes regime, emphasising that social support plays a big part in ideal serious game intervention. Secondly, the games' content can range vastly from RPG (Role Playing Games) adventure games to puzzle games. From analysis of game mechanisms that have been applied through the edutainment content in which a rewards system is inserted into the learning about coping with type-1 diabetes conditions and insulin balancing activities. Recently, there has been a focus within games systems on concerns to helping the patient's support network, as illustrated by Bayer Diget (2011), mySugr Junior (2016) and Monster Manor (2016). The players interact with their support network in the form of a diabetes data report to the caregivers. Lastly, the table shows the mechanisms applied to existing diabetic games, showing how the rewards system can be interspersed with learning about type-1 diabetes conditions, enabling patients to balance their sugar levels on a daily basis themselves, rather than based on the caregiver's interaction. Based on this analysis, it was possible to identify the design direction for the next stage of this research, in order to identify its unique position amid previous research and games developed in this area.

In exploring existing games for diabetic children in the market, there are two aspects that need to be taken into consideration: the game elements in use and the expected

outcome of the games. This provides a steer towards the gap in this research thus, defining new game solutions for diabetic patients. This analysis divided the characteristics of existing games into three main categories: 1) games that tend to give basic information about coping with type-1 diabetes, such as knowing one's glucose levels, insulin administration, knowing what to eat and counting carbohydrates and sugars; 2) games that motivate the patient to adhere to treatment; 3) games which aim to help the patient and their families organise nursing information, such as recording sugar levels and what they have eaten. In light of the above, there was a lack of evidence found that indicated the existence of a game that focuses on solving the problems of social support. This leads to revealing the gap in research and potentially providing the patient with a better model for behaviour change, particularly for diabetic conditions.

3.2 Review of formal academic research

In this section, the relevant academic studies focusing on the differences and similarities in serious games studies is explored. Given the lack of studies focusing on type-1 diabetic children, it would appear that research into serious games targeting specific users, restricted by age and geographic area, shows few results within the academic studies. Through an understanding of these studies, the evaluation of their key findings has revealed the gap which enables this research to position its focus in serious games, to contribute to new knowledge to the field.

One recent significant study was conducted by Thompson et al. (2010) who researched a conceptual model for the design of a serious video game promoting self-management among children with type-1 diabetes. The model was based on two main theories: social cognitive theory and self-determination theory, and it identifies how game play can be intertwined with behaviour change. The study's concerns focus on serious games practices through an understanding of psychological issues, emphasising how health psychology can provoke patient behaviour change.

PhD research undertaken by Baghaei et al. (2016) led to the design of 'Diabetic Mario', a game aimed at teaching diabetic children about healthy lifestyles and appropriate food intake. This game is based on the Mario game and has an engaging game mechanism and familiar interface for children. The game applied the coding structure of the Mario game[42], based on free coding provided online. The game was tested using a sample of

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[42] Mario is a game designed by Nintendo, featuring the characters of Mario and Luigi, and uses running and jumping mechanisms.

11 diabetic children to validate their comprehension and use of the 'flow state'[43] of a player's emotion in the game experience, as mentioned by Csikzentmihalyi and Nakamura (1989). He also summarised the findings based on Ryan and Decci's arguments, demonstrating that games should drive players through triggers that incite basic psychological human needs including competence, autonomy and relatedness (as discussed in the previous chapter, p.39). The research concluded that the principle element of serious game intervention includes usability[44] (comprised of audio, visual and screen layout), educability[45], mobility[46] and playability. The result of this research shows that applying this knowledge to serious game design can increase the confidence of diabetic patients with regard to their regular coping habits from 62 per cent before playing the game to 66 per cent after playing. This standpoint underlines the psychological potential within the game model for behavioural changes within patients.

Glasemann (2016) explored productive game elements with children suffering from type-1 diabetes in Germany through the collaboration of design activities with children who participated in a diabetic camp. Her study underpinned the concept of user-centred design that was steered by children's desires based on four fieldwork studies within the diabetic camp. The principles gained from the fieldwork were applied to mobile game app design thinking. Glasemann illustrated the 'MYLD' (M=mobile, Y=youth, L=learning, and D=diabetes) framework, mentioning three factors that contribute to the creation of an ideal diabetic health game, namely emotion, evolution and ecology. The theme of 'emotion' refers to the game allowing a diabetic child to think less about their condition being a burden and supporting the idea in a child's head that a diabetic patient is not ill per se. 'Evolution' focuses on a diabetic child's development resting on the concept of self-learning. She suggests that rather than a design being broadly used, a game should deliver adjustable features so that a diabetic child can tailor them to their own requirements. Finally, 'ecology' is defined as an imperative theme for designing games concerning two concepts, namely (1) connectivity and (2) possibility. Connectivity refers to the relationship between a diabetic child and their environment (i.e. sharing usage scenarios, sharing gaming progress and communicating with their

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[43] The flow state of emotion refers to a set player's emotions that are lied within the gameplay experiencing in each game's stages, which was initially demonstrated by Csikzentmihalyi (2001) as 'the state of intensive involvement'. He also argued that each stage of a game should provide the player with a different set of emotions.

[44] 'Usability' determines that a game can easily be played by diabetic children, and is composed of three main clusters: (1) acknowledging their instructional coping strategies through animation; (2) making sure the games have colourful, hi-res graphics; and (3) offering the patient consistent, logical and predictable results.

[45] 'Educabilities' refers to the cluster that aims to acknowledge the patient's coping knowledge. NiLufar et al. (2016) revealed that the participants preferred the teaching of their blood sugar levels through the medium of Mario games.

[46] Baghaei et al. determined that the term 'mobility' meant that games should be easy to play. However, their research found that 33% of participants designed the games in the form tablet devices' games.

peers), while possibility means opportunities to choose how they play within the game world.

Makhlysheva (2013) made a mobile phone game app for type-1 diabetic patients as a part of her Masters degree final project (Department of Computer Science, University of Tromso). She conducted fieldwork through questionnaires and focus groups to identify diabetic patients' needs in terms of serious game features. The study findings suggested that development guidelines for diabetic health serious games be made with an understanding of programming and from an engineering perspective, she wrote more than half of the thesis explaining the coding of the game data. The game provided the players with two functions: (1) teaching insulin balancing levels and (2) basic knowledge of food choice. This was tested with 18 diabetic child players aged eight to twelve and summed up into two dimensions of knowledge, focused on fun elements and a diabetic child required game functions. The engagement of game factors emphasised in this research are: (1) engaging the child with appealing character design; (2) providing a rewards system; (3) providing challenging tasks, for example, competitions and game difficulties; and (4) providing an attractive design. In terms of improving diabetic conditions, it was recommended to input appropriate knowledge into the game's functions. Makhlysheva also indicated that the game design in her study was more concerned specifically with the game's mechanisms, as some parts of the game were not of interest to the diabetic participants.

At the University of Texas, in Austin, George Washington Royer III (2017) conducted research into the design perspective in diabetic game management, as a PhD research study, which focused on the professional aspects of serious game design. The research arguments were synthesised into the 11 principles of serious games design, acclaimed as interrelated desirable elements (Royer III, 2017). The study was conducted to find the productiveness of users' game playing through three focus group interviews, by testing four existing games for diabetic management, *Equalise: Dependency, Coco's Coves, Tina the Cat,* and *The Diabetic Dog.* The research findings provided different aspects in diabetic serious game studies, and focused on the empirical knowledge regarding the persuasive game playing factors. He mentions 11 suggestions that will need to be applied when designing engaging diabetes games based on the feedback from existing diabetes games. (1) A game should give proper and clear feedback that identifies a player's action. (2) A game has to apply narrative structures that contain social networks and replayability features as well as offering a list of requirements that a patient must perform regarding their daily diabetic treatment. (3) A game should clearly identify the consequences which directly reflect on their diabetes performance outcomes, such as what happens when the patient eats the correct foods and has well-balanced sugar

levels. (4) A game should not depict an animal as the main character. His study found that diabetic children preferred a direct representation of themselves rather than a metaphorical representation. (5) A game should concern itself with mechanisms that are supportive of diabetic coping activities rather than borrowing well-known game mechanisms. The study found that most of the diabetes games that used popular game mechanics did not encourage coping activities based on feedback. For instance, the game 'Insulot' is designed with similar game mechanics to an ordinary slot machine. (6) A game should concern itself primarily with coping conditions rather than focusing on entertainment issues. (7) A game should be clear and precise as well as providing features that are driven by the actual requirements of patients (8) A game will be more interesting if it features unpredictable outcomes and obstacles. If a game only gives positive feedback, player might find that it is not as challenging or as fun as it could be. (9) A game should strike a balance between education and entertainment. (10) A game should offer players meaningful choices rather than provide a large number of choices that might lead to confusion. Finally (11) a game should avoid lengthy text-based instructions.

Chongsawat et al. (2016) investigated game intervention to increase a Thai diabetic child's learning abilities when coping with type-1 diabetes, through educational programming media targeting young children in Thailand (Mahidol University and Silpakorn University). The study focused on the effective features of diabetic health games, which could improve learning perception of young children through the lens of a medical perspective. It also recommended the appropriate game features for a child in their early years (six to twelves years old) of development.

'Dia-Beat-It' is a diabetic health game study conducted by Stone (2013), as a Master's degree project in Peter T. Paul College of Business and Economics. She developed a theory to understand diabetic health games' design from a marketing standpoint, focusing on the market positioning of diabetic mobile games applications targeted at users between twelve to thirteen years old. The findings of this research resulted in a marketing plan and recommended the sale of diabetic games in America within a year of 2013. The project was meant to be using glucose strips[47] in collaboration with the major pharmacies in the United States such as, Walgreen, CVS, and Walmart. The promotional strategies targeted diabetic caregivers as they play a vital part of diabetic caregiving, and could influence a child's parent to purchase the game. The majority of considerations stated in this study mainly focused on the possibility of marketing a

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[47] A glucose test strip is a blood glucose testing device aimed to help diabetic children to interpret their sugar levels at the time of insulin administration. Knowing their sugar levels helps diabetic patients to monitor and control them in daily life. Diabetic patients are to place a drop of blood onto the strip. The strip will interact with the glucose oxidase within the blood and the sugar level will be indicated at the end of strip.

diabetic game, positioned towards diabetics' caregivers and organisations, such as diabetic camp organisations and hospitals (Stone, 2013).

Additionally, the relevant academic studies regarding diabetic health games undertaken by Thompson et al. (2010), Chongsawat et al. (2016) and Baghaei et al. (2016) explored diabetic games based on an understanding of how the pattern of behaviour change can be achieved through the game's trigger systems. These studies provide an understanding of edutainment factors in the diabetic regime that need to be included in the game systems, as well as the appropriate coping activities for the pattern behaviour change that can be incorporated into the game. Studies by Lieberman (1988), Makhlysheva (2013), Stone (2013), Clasemann (2016) and Baghaei et al. (2016) provide diabetic game interventions driven from the perspective of computer science and an educational paradigm. For this research, it was found that the study conducted by George Washington Royer III (2017) shares similar objectives as those here, in terms of the identification of productive and persuasive game design guidelines, as the objective of the research. This PhD research, however, focuses on the role of a specific pattern of gaming attitudes performed and shaping the value of serious games from the diabetic patients and their parents' perspective, rooted in a geographical understanding, specific to Thailand.

Academic studies mentioned above, focused upon investigating the factors that can lead to productive outcomes for diabetic players in a Thai culture and context. Other studies have expanded knowledge of serious game design practice through the lens of a medical background, while some represented their findings through programming and a computer science perspective. A small number of academic studies investigated the actual game design perspective in order to construct an empirical, pragmatic knowledge for applied design within the serious game industry. For instance, defining a challenging task was repeatedly mentioned in almost every study mentioned above. Based on the game architecture, as stated in Chapter 2 (p.15), research has raised the argument that the term of 'challenging', as defined by these studies, is represented too broadly to be made by a game designer and is not pragmatic. Additionally, there are a lack of studies (n=14) concerned with the balance between the psychological aspect of a player's motivation and the external drivers of game design mechanisms to persuade the patient to develop a new behaviour pattern through the game design.
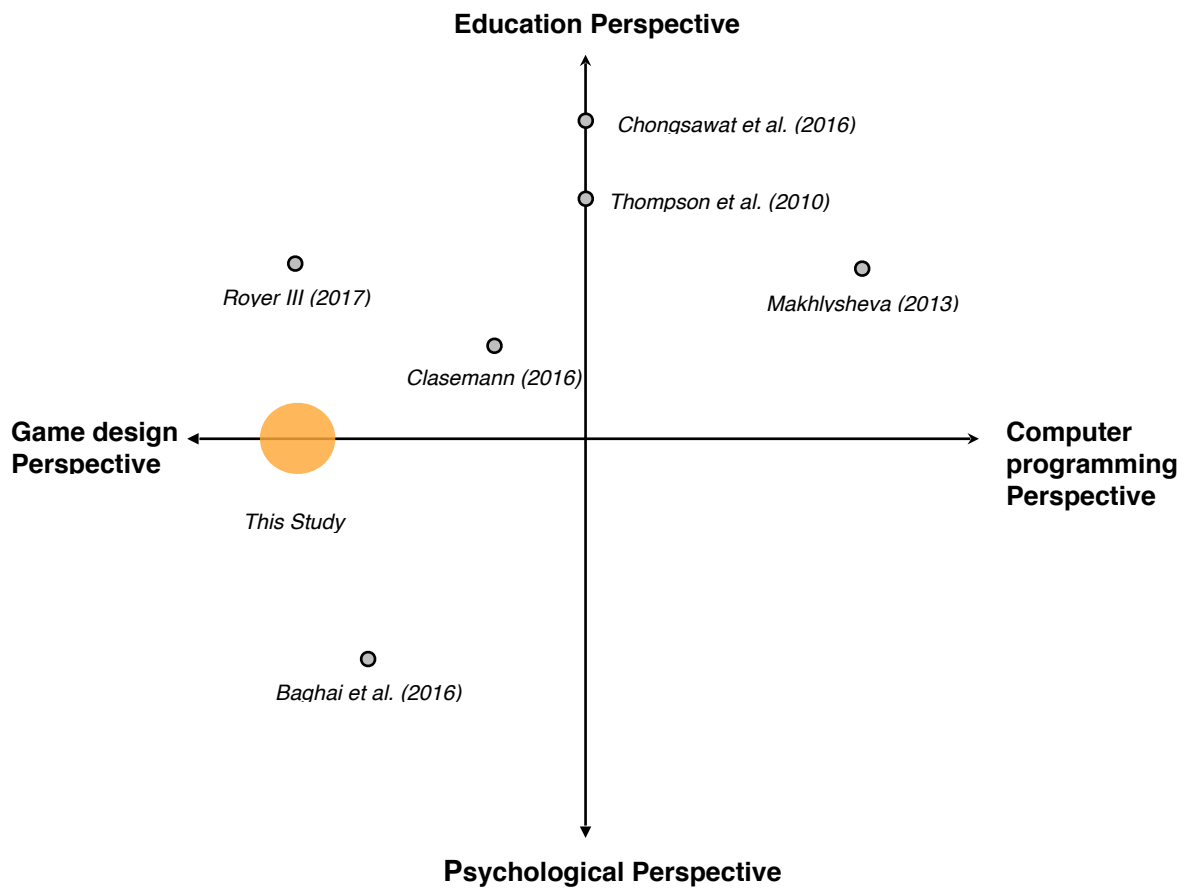
Figure 3.1 The relationship between the completed academic studies on diabetic games and this PhD research's positioning (Klangpremjit, V., 2019)

This exploration of existing formal studies has shown that this PhD project is uniquely placed in formal academic game studies. It is a contribution to new knowledge in serious game design practice.

To clearly position this research, the above diagram shows the relationship of the contribution of this PhD study with other completed research in the area of diabetic games studies. It identifies this study's contribution to new knowledge in which it is posited in the middle point position between an educational tool perspective and entertainment experiencing for young diabetic children. This emphasises the harmonising between the psychological knowledge behind playing games, and the behavioural knowledge to determine the design principles through the lens of the designer. This fills a gap in the knowledge in this area of practice, and leads to the research proposition that specific game design disciplines need to be driven from the understanding of the sociological context, to establish pragmatic design guidelines for Thai game designers.

Striking a balance between understanding the psychological aspects and educational perspectives can provide a serious game designer with new understandings. Those designers that can successfully identify how the physiological needs behind playing digital games will be able to create the persuasive triggers that tend to be used in instructional games. Additionally, this notion amplifies how instructional games can be created based on the design consideration of games designers.

3.3 Case studies analysis

This section aims to investigate other non-medical successful game designs that target young children, particularly in Thailand from 2014-2018, to exemplify the specific ways that the architecture of these games has engaged players. Objectives determined at the beginning stage of the case studies analysis were: (1) to explore the game mechanisms used within the games; (2) to investigate the factors of productive play that emerged from player interactivity; and (3) to identify the common elements used to engage a player. The considerations taken to analyse these game design cases are based on the research approach in the early stages of this study, as discussed in Chapter 2 (identifications of persuasive and productiveness of serious games design factors). On investigation, the factors that have made these games popular in Thai society, include two dimensions of focus, intrinsic motivational triggers and external game mechanisms used within the game. Two games were selected to represent the success of the general game design models, according to the marketing reports during the research period, namely, Cookie Run (2014) and Pokémon Go (2016). Two other game case studies were also reviewed, based on having the most relevance to the aim of this study regarding games for diabetes management for young children, namely, Insulot (2005) and mySugr (2013). During the research period (2014-2018), there was no evidence indicating the launched of related diabetic games in Thailand. The examples of games in this section were selected based on the aims of the research and are focused on download numbers. These games will be analysed in the following sections.

3.3.1 Pokémon Go: the phenomenon of prolific playing pleasure
In 2016, Pokémon Go was launched, in a blaze of publicity, as the bestselling game of that year, with 550 million installed on mobile devices, published by the Ninatic company. In Thailand, the game became the most downloaded application and was named by Marketing Oops (2016) as the most addictive game of the year (Fayossy, 2016). The successful outcomes of this game were intriguing to investigate specifically due to what factors make Thai children engage with the game, and which of these will aid in the construction of a set of game elements.

Figure 3.2 *Pokémon Go game launched in 2016 (Gibbs, 2016)*

Pokémon Go is an augmented reality-based game, allowing the player to explore the physical world through the task of collecting virtual pets. The player has to explore the real world to collect, customise, and train their pets to expand the game's playing abilities. A player's avatar is represented in the virtual map, displayed as a physical map based on the player's geographical location. The game connects the physical world with the virtual world through a mechanism that involves the player moving within the surrounding real world which causes the avatar to move within the game's map.

Taking Pokémon Go's game play mechanisms into consideration, the game was analysed based on an understanding of persuasive games factors, which were discussed in Chapter 2 (Identifications of persuasive games outcomes). The game encourages the players through two strands of persuasive motivational factors, intrinsic and external game triggers. From the intrinsic standpoint, there are four significant types of motivation used to encourage players; (1) a sense of ownership; (2) a sense of exploration; (3) a sense of achievement; and (4) social impacts. First, the most imperative part that influences players to become embedded in the game is the sense of ownership. The game delivers this to the player when the pets are successfully caught and this is highlighted by the fact that players can also customise and develop the pets within the game world. From the research point of view, the functions that allow the players to explore the limits of the physical world successfully engage the users by being correlated with the players' feelings of ownership, as the player would want to go

further to develop their pet's performance. The notions of achievement can be seen in the game through players seeking to extend their pet's performance, and by being able to fight with another player's pet, linked with the real geographical world. This also addresses the feeling of competition, as the player aims to compete their pets with others, represented through their pet's unique customisation and training.

From the extrinsic standpoint, the storyline of this game presented through its Japanese animation, Pokémon, was familiar to Thai and global children and gamers before the game was published in 2016. The story of Pokémon involves a ten-year-old boy, Ash Ketchum with his monster Pighachu and his adventures to become a successful monster trainer. This popular story was used as a productive trigger for younger children, but also people of all ages, as the Pokémon game story gave them a simple storyline and an escape from reality. This is highlighted by the representation of similarly aged players and the characters within the storyline, as real ten-year-old boys and girls. In addition to the storyline, the game provides players with responsive feedback through progressive rewards for their playing performance, provided by features to upgrade their monsters, virtual tokens, leaderboards and badges (novice to master of monster trainer). For the players, this emphasises the fact that social aspects play a part in persuading new players to play the game, as they do not want to be isolated from their social group. This can be promoted by the features of leaderboards and monsters fighting.

Other factors that made the game popular in Thailand during that period were: (1) the game was easily accessed on a mobile device; (2) it presented the player with new technology, such as augmented reality to connect the physical geography with the game world, which enabled players to roam and explore; and (3) the game balanced its appearance: between a casual mobile game and the traditional look. Based on these factors, Pokémon Go provided evidence that game newcomers can be a part of the gaming culture and play the game.

Although the persuasive factors in this game might be used as an effective tool to persuade the players, it was discovered that some features within the game system might not be suitable for this research context. First, to be a master of game playing, the player has to roam and further explore the physical world. This means that, for young children who have a lack of experience in exploring the real world, they will find it hard to master to game's mechanisms. Secondly, the game interface and information system are not appropriate for this group's development, as they provide a number of complex signs and metaphoric information which is too hard for early age children to interpret. Lastly, using augmented reality to promote game experience is intriguing for game design, but it is important to take into account of ownership of expensive products for

young children, such as the cost of a device with a camera, and how to responsibly market them to a child of this age.

3.3.2 Cookie Run: linking people with competitive fun

Cookie Run is an endless running competition based game, launched by the Korean company, Devsisters (2013). The game offers the players game rules to brag to each other about, such as how far they can go while escaping from obstacles within the game, through the number of cookies they have collected while running. The success of Cookie Run was indicated through the download numbers across Thailand and was the number one most downloaded mobile app in the year of 2014-2015 (Cheng, 2014).

Taking into consideration the extrinsic motivation triggers, the game significantly persuades and nudges players through the cookie rewards system. The number of cookies that the player collects directly affects the abilities of their avatar to go further. This can nudge the player to constantly play through the triggers of the buying accelerator equipment, enhancing the avatar's abilities to absorb the surrounding cookies, and virtual pets help the player's avatar in collecting cookies. Furthermore, an unlocked system is delivered to challenge players to gain sufficient tokens (cookies) to buy characters within the game. This technique promotes the player's desires by launching new types of characters each month, encouraging players to look forward to seeing them. This design technique can be used to encourage players to continue playing, as they expect to see new characters and their abilities to help them collect the cookies. The results of game playing (number of cookies collected from the distance they can run) are represented through leaderboards, which instil feelings of competition embedded in the game.
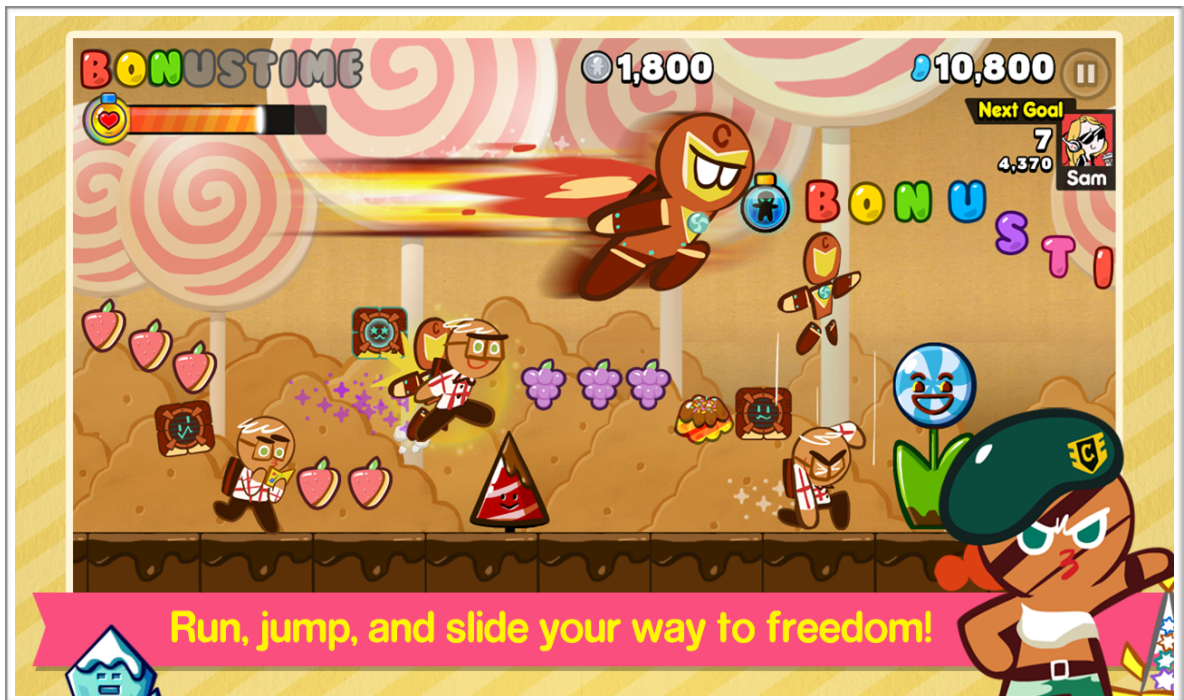
Figure 3.3 Cookie Run games mechanisms (Cheng, 2014)

Another effective factor that persuades new gamers to become addicted is that the game offers them easily interpreted rules, by designing a vertical perspective and sequence of difficulties with regard to the game's obstacle, based on up and down controlling. This style of game playing is adapted from the popular classic game, Mario Bros (1983)[48], which rapidly became the face of game playing.

From the standpoint of intrinsic motivation, the game significantly delivers players with the feelings of competition, ownership and accomplishment. This game is linked with the mobile chat application Line[49], which has been widely used in Asia since 2014. The scores of cookie–based games will be represented in the user's profile within the application. This aspect of competition is represented through the bragging concept in the form of a leaderboard that shows the player's cookie character avatar and the scores that they have gained. A sense of ownership is shown by the system of unlocked cookie characters, avatar pets, and cookie customisation tools that can represent the player's creativity through their cookie's outfits. In addition, the players also get a feeling of accomplishment by unlocking the different stages and levels.

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[48] Mario Bros is game run by the mechanisms of jumping and running through the characters of Mario and Luigi, designed by Nintendo company.

[49] 'Line' is a chat application invented by the Japanese company, Line, that encourages people to interact through various methods of communication, such as stickers to represent your emotions, games and video call features.

There are other factors that supported the game's success in Thailand between 2014-2016, such as the advertising campaign that used influencers to promote the game through the social media, combining with the famous Line chat application, and using techniques that urged players to invite newcomers to gain tokens in the game. From this research perspective, the mechanisms applied within the Cookie Run game have potential to achieve productive outcomes, such as: (1) the game drives players through easily interpreted playing rules and methods making access easy for every type of player and specifically for young children; (2) the game successfully links the players through the mode of competition, as shown by the number of downloads; and (3) the game's appearance, which appealed to the wide range of targeted player and which is correlated with the purpose of this study, as it is meant to be used by a myriad of young child player types. However, for this research it also has to address whether the competitive fun element, which has successfully attracted players to play, is still suitable for a diabetic game as it is supposed to be well-balanced between an entertaining experience and coping strategies for a type-1 diabetes regime.

3.3.3 MySugr Junior: Managing diabetes conditions through virtual pet system

MySugr Junior is a diabetes management game that allows a diabetic child to record and manage their diabetes data. The game mechanisms are used to encourage diabetic children to constantly organise and focus on their health, especially their abilities to administer their own insulin, maintain their sugar levels, and count carbohydrates. Furthermore, the game also connects caregivers and diabetic children through the note mode, which allows caregivers to give and review the feedback of daily diabetic outcomes. The virtual pet is the strategy that the game uses to encourage the diabetic child to constantly keep playing, by using the score to balance the mood of the monster in order to tame it. Appropriate amounts of insulin intakes, sugar levels and carbs will be turned into points, which keep the monster in a good mood. As with the previous games mentioned above, MySugr will be explored in two aspects of the game's motivation.
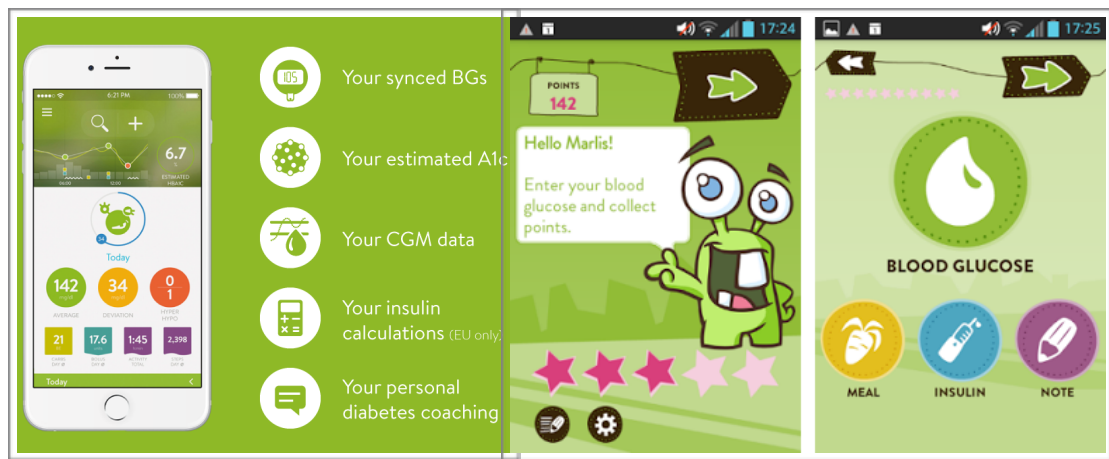
Figure 3.4 MySugr Junior game launched in 2013 (Barry, A., 2016)

The game applies mechanisms to persuade the player using superficial game motives. From the extrinsic standpoint, the game uses a rewards system to encourage the diabetic child to balance their conditions and report to their caregivers through the mode of notes. The game was not only purposed for engaging the child to record self-data, but it was also aimed at connecting the child patient and caregiver through their reported data, such as food intakes, sugar levels and insulin dosages. Caregivers can send feedback to their diabetic child through e-mail. Applying none of the storytelling visual images and amount of data have led to it being positioned in a place similar to diabetic data management applications, rather than as a serious game itself. The game mainly focused on the diabetic child's self-data that reflects their treatment regimen throughout the day. The caregiver can send feedback that responds to their child's performance, such as counting carbs and adjusting insulin dosage. The question arising from this is whether offering to record a large amount of diabetic text data, specifically with carb numbers and insulin intake, is suitable for young children ages five to six years old. Additionally, is using the virtual pets mechanism and rewards system sufficient to engage young diabetic players to play regularly?

Feelings of ownership and achievement were significantly applied to the game through the mode of virtual pet, and in balancing the pet's emotions. Furthermore, the relationship between the diabetic child and their caregiver was enhanced through the feedback features that allows caregivers to review and react to the child's results. However, it raises questions regarding the game's trigger mechanisms, and whether using just a few rewards strategies can sufficiently motivate the child and lead them to upload their daily condition, if only to please their caregivers. Moreover, the feeling of being connected is intended to be supported by the features from the caregiver's report. From this perspective, it was found that the game raised some interesting concepts: (1) the features used to create a link between the caregiver and the child; (2) the concept of

balancing the diabetes condition with virtual pet progressing; and (3) the idea of visualising diabetes data reports.

3.3.4 Monster Manor: enhancing monitoring glucose levels experiencing

Monster Manor is a game that aims to entertain the diabetic child through the mechanism of using virtual pets as monsters. It was launched in 2013 through a partnership between Ayogo, a British company and Diabetes UK. The game play seeks to encourage the player to keep sugar levels well-balanced in order to gain a sufficient score to upgrade and unlock the monster in the house. As with mySugr Junior, the game situates players as the owner of the manor house where the player has the role of taking care of the collected monsters, by balancing sugar levels and frequency of diabetic data reports. The result of logging sugar levels and uploading the data into the game app is turned into scores that can support monster conditions within the game and is partnered with Bluedrop, a diabetes sugar level tracking application. This game was reported by Oxford of Academic Health Social Network (2014), as successful and in demand by diabetic children aged five to ten years old in the UK, compared to the diabetic patient population (approximately 5,000 of type-1 diabetes in UK) with 1,238 downloaded hits from both Apple and Android.

From the extrinsic motivation standpoint, the game uses a virtual pet strategy, with the fantasy world of a manor house, a rewards system, and a connection between the diabetic child and caregivers in the form of rewards. The mechanism triggers within the Monster Manor game are similar to the MySugr Junior concept. However, the visual representation of Monster Manor is more focused on having an appealing look for children and immersing the game in the mood and tone of a monster's world. In this game, the mode of diabetic data representation is visualised by a reduction of the amount of text into images and signs. In this game, the data is visualised in the form of numeracy and short sentences to make it easy for the child to decipher for his or her condition.

Taking this game into consideration, it was found that the idea of portraying diabetic conditions through a virtual pet's condition is widely used for the function of diabetic management. Monster Manor is positioned in promoting a game of health management, rather than focusing on giving a diabetic child instructions to cope with their type-1 diabetes condition. As such, the function aimed to manage sugar levels and record food intake in order to maintain and unlock monsters. This game does not provide the diabetic child with pragmatic strategies to interpret their insulin meter level, which is supposed to be accurate compared to the reality. This would suggest the need to maintain the use of both a functional glucose monitoring device and a mobile

application, as Bayer Diget did with Nintendo DS[50] (2011), with which the game shares the similar purpose of maintaining the balanced of insulin and sugar levels. However, it was found that there are some features that lead to concern in the next step: (1) making the game appealing to children; (2) using the metaphor of a monster's performance to relate to a diabetic condition; and (3) visualising the amount of information of diabetic data.

Figure 3.5 Monster Manor game launched in 2013 (PMlive, 2013)

3.3.5 Conclusion of case study data analysis

Four types of games divided into two categories were analysed: two general games popular in Thailand during the period this research was being conducted (Pokémon Go and Cookie Run) and two widely recommended diabetes games (Mysugr Junior and Monster Manor). It has been demonstrated that there are similarities and contradictions in the motivational game triggers used within the games, based on a set of indicators of persuasive serious games defined by serious games scholars (Chapter 2- Literature Review). The purpose of this analysis was to define the game design elements that have the latency to maintain a persuasive gaming experience which can be applied within the game design in the next part of this research to test the theory developed herein in practice for designing games.

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[50] 'Nintendo DS' is a compact mobile games console designed and produced by Japanese producer, Nintendo. The Nintendo DS allows players to operate the games' system through a multi-touchscreen. Two touchscreens are integrated within the console.

The two tables below support this analysis: the first table represents concepts of extrinsic motivational triggers used in each game, and the second table represents the intrinsic motivation triggers used in the games evaluated here.

Meaningfulness of persuasive serious games factors identified by the games scholars				
Persuasive serious games design components	Pokémon Go	Cookie Run	mySugr Junior	Monster Manor
Focuses on game design elements				
1.) Defining a clear goal	X	X	X	X
2.) Being challenging	X	X		
3.) Allowing the player to practise the tasks				
4.) Providing a sense of pleasure	X	X	X	X
5.) Narrative operator-using the storytelling	X	X		
6.) Being fantasy	X	X		X
7.) Obtaining various choices	X	X		
8.) Providing achievable tasks	X	X	X	X
9.) Providing immediate feedback		X	X	
10.) Understanding the users and surrounding context	X	X		

Table 3.2 *The extrinsic motivational elements used in each game (Klangpremjit, v., 2019)*

Meaningfulness of persuasive serious games factors identified by the games scholars				
Persuasive serious games design components	Pokémon Go	Cookie Run	mySugr Junior	Monster Manor
Focuses on psychological elements				
1.) Social impacts	X	X		
2.) Provoking imagination	X	X		
3.) Ownership and profession	X	X	X	X
4.) Empowerment	X	X	X	X
5.) Scarcity and avoidance		X		
6.) Being fantasy	X	X		
7.) Sense of exploration	X	X		
8.) Curiosity and unpredictability	X	X		
9.) Meaningful fulfilment	X	X	X	X

Table 3.3 The intrinsic motivational elements used in each game (Klangpremjit, v., 2019)

From the table above (3.3), it was discovered that the games that were popular in Thailand during the research process, fulfilled almost every aspect of both intrinsic and extrinsic motivation for players, although diabetic games still lack the intrinsic motivation elements. This tells us that diabetic games which currently serve patients are still showing a lack of concern for design or game play considerations in terms of fulfilling the notions of intrinsic game design triggers. From this exploration, it is clear that social influences play a major part in a player's motives to play the game, as can be seen with both Pokémon Go and Cookie Run, which achieved the most downloads of mobile game applications in Thailand between 2014-2016. However, the concept of interacting with society appears less important to diabetic games developers because of the low number of patients with type-1 diabetes. This raises the question as to whether the low number of diabetic children can be affected by the social influences of motivation to play the game, and what are the game mechanisms that could drive players to play in terms of the social impacts.

Additionally, this also reveals the gap in the field, none of these diabetic games (as based on Section One) focus on practicing tasks because that situates the player in real world situations, for example, counting carbs and practicing insulin intake. Additionally, the ability to immerse the diabetic child player into immersive game appeal along with

the diversity of psychological triggers within the game still needs to be investigated. From the research perspective, existing diabetic games the market have delivered diabetic players with a sense of edutainment, rather than immersing them into the actual full immersive game experience. What emerges is a hypothesis that, to be close to the ideal characteristics of diabetic games and provide players with engaging play experiences, the game should maintain both diabetic coping features and offer players a diversity of intrinsic and extrinsic core drivers.

3.4 Summary of key findings

This chapter has investigated three considerations: (1) a review of existing diabetic games in the healthcare industry; (2) a review of formal academic research into diabetic serious game design practice and (3) four case studies and their analysis. Based on the insights gained from this section, it is possible to identify the gap in the field and in academic studies, and thus a clear contribution to new knowledge in the diabetic games industry and games research. The gap indicated in this chapter reveals the potential to take into consideration an area previously not addressed in the diabetic healthcare game development. Through the explorations in this chapter, it was discovered that the lack of research in this the area highlights a gap in understanding the impact of how specific geographical identities play an imperative part in productive persuasive game playing factors. This shows that the exploration of knowledge in this specific geographical area (Thailand), the specific age of the diabetic child player, and the construction of the design guidelines through the eyes of a game designer's paradigm has been presented as an ambiguous issue.

Due to the lack of data considering empirical findings of persuasive diabetic game outcomes, driven by the specific geographical factors, and the user's age, ambiguity exists within this area of design practice. This has guided the research to find new methods of practical games design to fill the gap, which are to:

1) Apply pragmatic diabetic game design principles to a new game for five to six years old Thai children with type-1 diabetes;

2) Identify and investigate type-1 diabetic patients and caregivers' experiences with coping strategies and their difficulties in the daily regime that may have emerged from their constrained facilities context.

The contextual reviews in this section reveal that most of the game studies identified the productive experience of game design outcomes. This was done by adopting the concept

of user-centric design through methods that tend to understand diabetic children's requirements and thought processes. For instance, Glaseman (2016) applied participatory activities through a focus group interview by allowing the participating children to design games based on identifying gaming triggers. Also, George Washington Royer III (2017) gathered children's feedback on existing diabetes games through focus group interviewing and attempted to interpret their thoughts. From this notion, in order to serve specific diabetic child players with productive diabetic games intervention, the research raises the question as to whether using the methods of focus group and interviewing are sufficient to gain insight into the effectiveness of the games, the specific motives of playing digital games for behavioural change, and development the behaviour pattern change for type-1 diabetes. As a consequence of the absent data in this area of diabetic game design practice, the ambiguous nature of the information regarding the game design process, along with the health behaviour change considerations, the outcomes have yet to be declared. In this study, the aim was to shed light on the game design process and design methodology that can be adapted for the game designer, with a model to integrate game mechanisms into that of behaviour change for Thai diabetic children.

Chapter 4: Research methodologies

Methodology and methods used to define persuasive game playing of Thai early age players

This chapter will explain the research methodology adopted in this study. It has been divided into five subcategories:

1. Research approach
2. Methodological process
3. Data collection
4. Methods
5. Ethical considerations

The overall research methodology for this research will expand on what has been used in previous related studies to game design practice. It is critical to gain a deep understanding of which methodology could be applied to this specific study. The focus of the investigation is to answer the research questions posited in Chapter 1 using Information Systems (IS) research methodology (Kroenke, D., 2015). Choosing the appropriate methodology to accomplish the objectives has helped the investigation into the strategies and techniques for data collection that are employed in this research and discussed further in this chapter. The tools used to examine the data from the fieldwork, and to explain the emerging phenomena when observing the targeted users, will be defined herein, and were primarily based on design ethnography, described in detail further on. However, before explaining the design of the methodology used, the research paradigm for the methodology will be presented. Prior to undertaking this research, the appropriate design methodology was reviewed and chosen to answer the research questions.

For this purpose, the Information System Research, two methodological approaches were used together, which were, behavioural science and design science. This helped in the understanding of the patterns in patients' experience, and create a software intervention for a better health regime. Qualitative ethnographic case studies and in-depth interview methods were chosen. By outlining IS design methodology, this chapter will also define in detail the other methodologies and methods adopted for this study, as illustrated in Image 4.1.
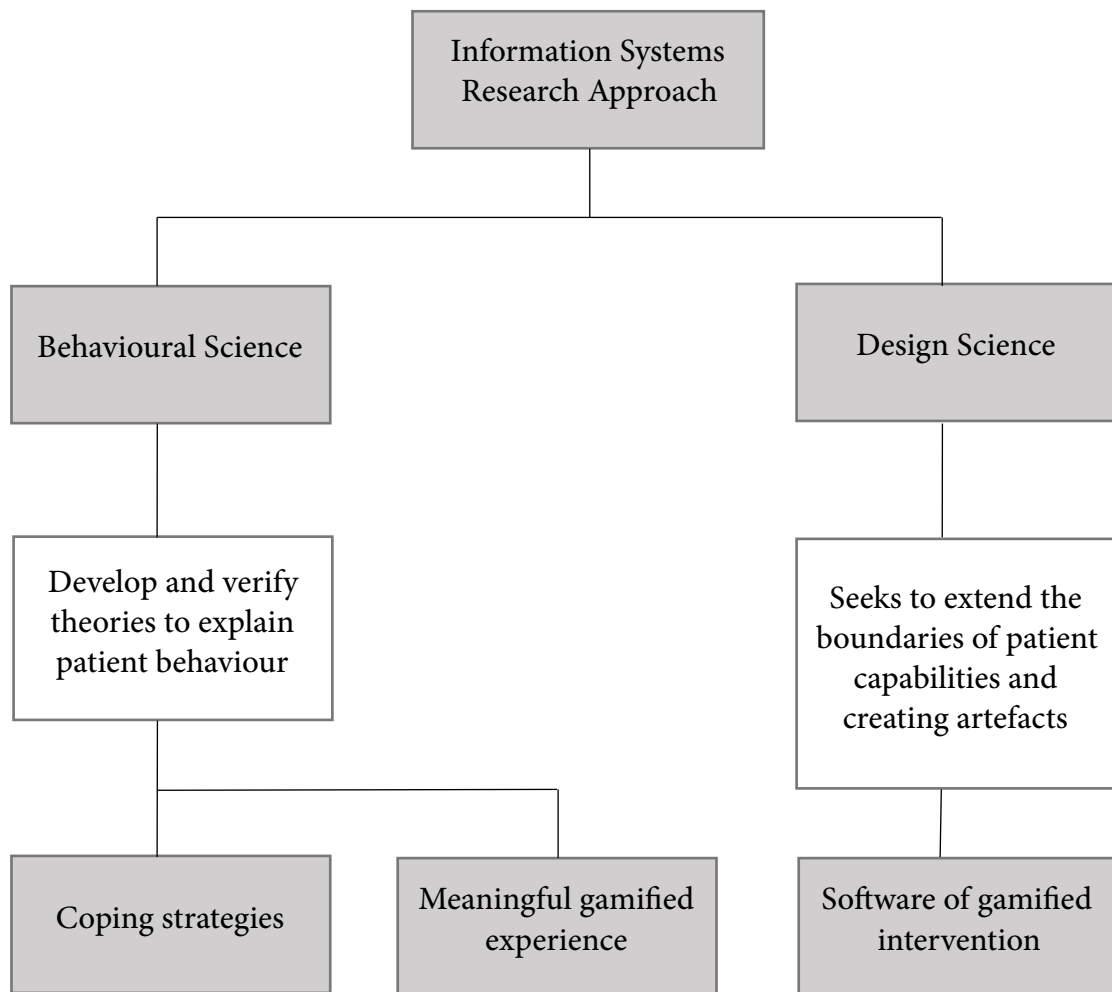
Figure 4.1 *The diagram of IS methodology, adapted for this study (Klangpremjit, v., 2019)*

4.1 Information Systems Methodology

The objectives of this study acknowledge the exploration of various methodologies to seek out solutions. After defining the problems of nursing strategies, understanding the issues for type-1 diabetics, is crucial when the patient is newly diagnosed. One of the objectives is to provide a good understanding of the patient's condition, so designing an IS study, through the lens of games mechanics, is required. Based on this, 'information systems' form a research approach defined as a group of components that interact to produce information (Kroenke, 2015).

IS research is the discipline of studying the effect of IS on a target group's behaviour (Galliers, 1992). The behavioural science paradigm is used to explain and understand a target group's behaviours, in order to access deeper insight. The design science paradigm aims to help in the understanding of the target group's capabilities and use this insight to develop design principles for them (Hevner et al., 2004).

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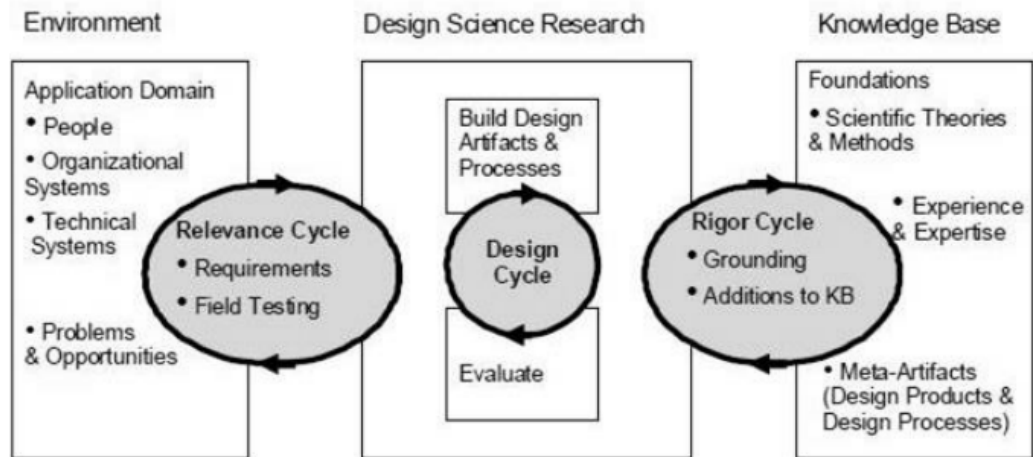
Figure 4.2 The information systems research framework, showing the inherent research cycles (Hevner, 2004)

In contrast to Hevner et al. (2004), Nunamaker, J., Chen, M., and Purdin, T.(1991) demonstrates a multi-methodological approach consisting of three paradigms of IS research: theory building[51], experimentation[52], observation[53] and system development[54]. Similar to March and Smith (1995), the output of the qualitative methodology of 'IS research' is divided into four categories: construct, model, methods and instantiations. Construct refers to understanding and categorising the target group phenomenon. Model identifies the mediation or model of intervention made by the designer. Methods refers to how the target group operate the model of intervention. Lastly, instantiation means the 'physical implementations intended to perform the certain tasks' (March and Smith,1995).

According to Nunamaker et al.'s (1991) statement, there are three research strategies in IS research: research hypothesis, conduct observation, and design experiment. Theory building refers to exploring the principles and studies which might lead to a research

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[51] The term 'theory building' refers to development that resulted from new ideas and concepts, including new solutions, new methods and new knowledge (Nunamaker et al., 1991).

[52] Experimentation focuses on strategies to seek out new solutions for the research project, such as using laboratory and computer information (Nunamaker et al., 1991).

[53] Observation focuses on methodologies that a researcher would normally use to immerse themselves in an actual situation in order to experience general feelings about the participants' environment without interference (Nunamaker et al., 1991).

[54] System development is the term used to determine the research outcomes. The concept includes five stages of system development: (1) designing the concept; (2) structuring and ordering information within the system; (3) prototyping the mock-up, which would be tested on the participants; (4) developing the model prototype based on feedback on the previous model; and (5) transferring the technology that represents the outcomes of a research project (Nunamaker et al., 1991).

hypothesis or guidelines for designing and testing a design. It is also useful as a guide for collecting fieldwork. The observation stage is designed to help the researcher define their research hypothesis, or allow them to focus on the issues that will help to produce the design information principles necessary for the design. Lastly, the experimentation stage refers to the stage, including the field experiment, which allows for the authentication of the theories and intervention of information system. Nunamaker et al. (1991) also demonstrate the procedures of conducting IS research methodology in five staged methods: concept design, designing the architecture of IS, making the prototype, product development and technology transfer.
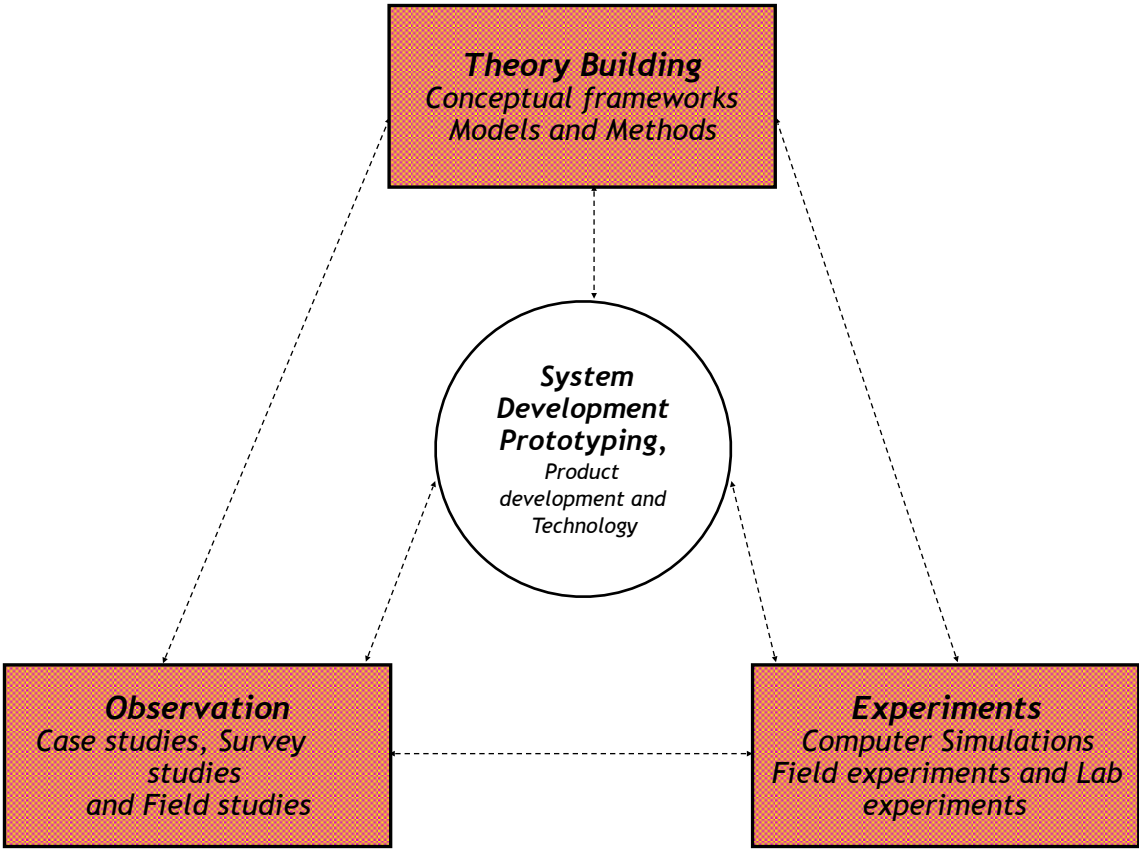
Figure 4.3 Information Systems Methodology (Nunamaker et al., 1991)

Together these studies provide important insights into the navigation of this research and its combined methodologies. From the behavioural science paradigm, this research attempts to understand patient behaviour to define the problems of nursing strategies, whereas the design science paradigm enables the results to enhance the child diabetic patient's experience with coping mechanisms for their diabetic condition, by designing a gamified medical intervention. Utilising the two elements of social science and design research, the methodology used relies on the model of information research and Nunamaker et al.'s (1991) system development methodology.

Behavioural science is used to understand the target group to define the nursing strategy problems in real-life situations and the meaningful gamified experience of Thai children ages five to six years. Previous research with similar research questions around revealing the problems of coping strategies will be examined next, especially those that relate to nursing interventions and serious game design for children. Salmelia (2010) researched hospital-related fear strategies in children ages five to six years, for the purpose of finding the explanation to this particular phenomenon in health care. Salmelia divides her research question into two main categories: (1) coping strategies and (2) hospital-related fears of children ages five to six years (Salmelia, 2010, pp.20–22). For each research question, she uses a mixed-method research approach to answer her research questions. For nursing strategies, Salmelia used a qualitative research approach by using observation, in-depth interviews and questionnaires to examine hospital-related fears, while coping strategies were investigated using quantitative research methods. Other related studies focusing on holistic health care service and medical design intervention have been reviewed to discover how these methodologies were used to answer similar research questions. It was found that in selecting a methodology, a qualitative research approach is frequently used to understand the targeted groups' real-life activities (from 2014 to 2018). A summary of the concepts involved in selecting a methodology is shown in Image 4.4.
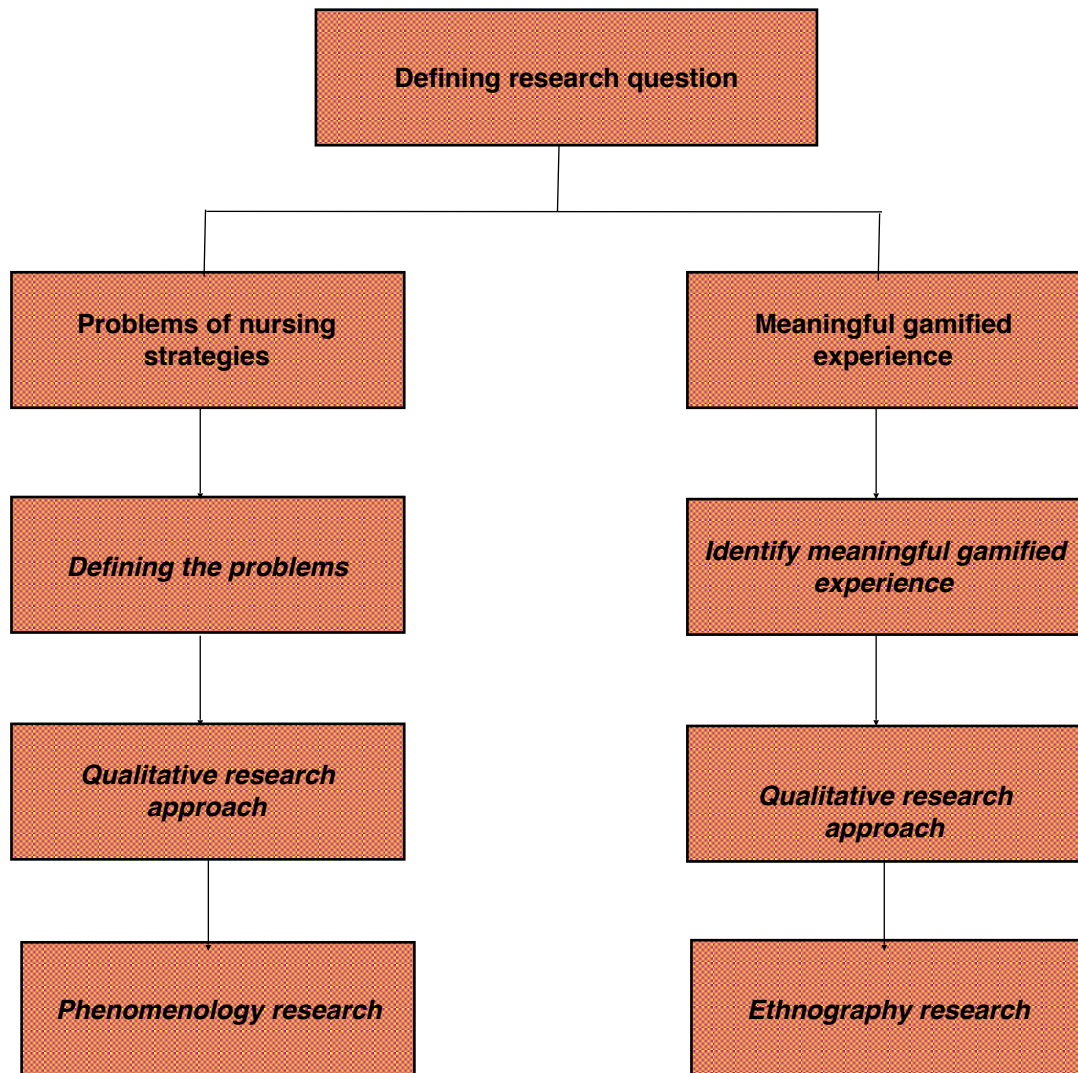
Figure 4.4 *diagram of the qualitative approach that has been adapted in this study(Klangpremjit, V., 2019)*

4.1.1 Behaviour science and Design science paradigm

As mentioned above, behaviour science seeks a deeper insight into a patient's and target group's behavioural needs, to find out the most appropriate methods. The methodology most commonly used in the area of design research is qualitative and usefully supplements and extends a better understanding of the type-1 diabetic patient's situation evident from previous related research, with similar expected outcomes. Based on the exploration of the existing academic research discussed in Chapter 3, all of the studies on serious games for diabetic children have been conducted through the lens of qualitative studies to explore the effect on their targeted users' requirements.

The 'design science' paradigm refers to a paradigm that contributes new knowledge through new solutions, strategies and interventions – those that are aimed at responding to the needs of the targeted users. The term 'behaviour science' was first coined by Hevner et al. (2004) in the IS research methodology as a paradigm aiming to justify and understand users' requirements. In IS research, this paradigm seeks the truth about user context and focuses on user's behaviour to identify the rationale behind their actions (Hevner et al. 2004, p.60). On the other hand, the paradigm of design science concentrates on knowledge creation through methods that formulate new intervention or design.

In this study, the research questions will be allocated to each characteristic of the IS research paradigm (as shown in Image 4.4).Understanding users' needs and requirements will be explored through the concept of behavioural science, while the design science paradigm will be applied to help create and develop a prototype of a diabetic health game.

4.1.2 Qualitative research approach

Quantitative research methods are commonly used to find, simplify, and describe patterns through statistical means (Lewis-Beck et al., 2004, p.896). Muratovski (2012, p.216) suggests that the researcher can use this approach to examine a particular group of people or test a design outcome. Qualitative methods rely on the notion of detemining and gaining access to the target audience and their cultural context in real life (Guba and Lincoln, 1994; Silverman, 2000; Gray, 2014). 'According to qualitative critics, qualitative research claims objectivity, but ends up arbitrarily defining the variables in their research, or trying to explain away correlations using common-sense reasoning' (Gray, 2014, p.160). Some qualitative researchers criticise quantitative research because the information, defined by statistics through the quantitative approach, is interpretive, as it is based on many factors, and might be attributed to the researcher (Gray, 2014). However, there are also certain drawbacks associated with qualitative approaches to investigate the potential of designing intervention for patients, studying the attitudes on social issues and understanding the perception of the product. The qualitative approach was employed because the aim was to get a deep awareness of values and perception and how the child diabetic patient can be persuaded through the tools of gamified elements.

In this study a multidisciplinary approach, which aimed to investigate the phenomena in Thai diabetic children, incorporated all three methodologies (Design Ethnography, Information Systems and Phenomenology) to make a meaningful gamified experience for children, and to define the problems of coping with a diabetic condition. It aimed to

understand and study the phenomena that occurs in a natural setting and investigate them in all their complexity (Leedy and Ormrod, 2001, p.135). Two qualitative research traditions were used: ethnography and phenomenology traditions, these will be discussed below in section 4.1.4 (p.75) and section 4.1.5 (p.76).

The case study approach was not chosen because the results would not portray the whole picture of a Thai diabetic child's experiences with nursing strategies. In addition, ethnography is one of the methodologies commonly used to explore an in-depth, systematic study about a group of participants (Madden, 2010). The purpose of ethnography research is to gain a holistic insight into the participant's culture. Reeves et al. (2008, p.512) also suggest that ethnographic research performed by interviewing, observing and participating helps gain insights into the patient's world. Lastly, phenomenology research was used to understand the participant's perspective on his or her situation (Leedy and Ormrod, 2001, pp.136–137).

Characteristics of Research Approaches

Dimension	Qualitative Research	Quantitative Research	Visual Research	Mixed Method	Applied Research
Research Purpose	*Seek to explore and define the phenomena*	*Seek to confirm hypothesis phenomena.*	*Seek to study images, forms and objects*	*Seek to quantify variation and predict causal relationship*	*Seek to investigate and develop their work*
Disciplinary Origins	*Philosophy, Sociology, Anthropology, Multidisciplinary roots*	*Philosophy, Sociology, Anthropology, Archaeology, Art*	*Philosophy, Sociology, Anthropology Archaeology, Art*	*Multidisciplinary roots, including Business Law Social Science, Medicine and Education*	*Art*
Collection Methods	*Observation, Interview, Focus group, Cultural probe*	*Interview, Questionnaire and Survey*	*Collection of images, objects and decoding*	*Combining qualitative methods and quantitative methods*	*Practice-based research and practice-led research*
Data Analysis Approach	*Holistic description and search for cultural themes in data*	*Seek to explore and define the phenomena*	*Critically examine images, form and objects*	*Description of topic and people being studied and ended with selective coding*	*Holistic description of new understanding about the practice*
Narrative Reports Focus	*Rich description of the essential structures*	*Numeral obtained by assigning numerical values to responses*	*Rich description of studying of the visual and materials*	*Holistic description of topic and people being studied*	*Holistic description of new understanding about the practice*
Applied research methodologies for this study	*X*	*-*	*X*	*-*	*-*

Table 4.1 *Comparison of research traditions in qualitative research (adapted from Cresswell, Fetters and Ivankova, 2004, p.65)*

4.1.3 Design Ethnography

For the next question, answers were sought for what constitutes a meaningful gamified experience for children ages five to six years, Ethnography would best suit this research question as it is frequently used to support a better understanding of the participants in their natural setting. The gamified experience, children's interests and their parent's attitude to gaming will be investigated through the eyes of traditions of ethnography by using the observation method, focus group, questionnaire and cultural probes.

Ethnographic methods are relevant here to explore knowledge that focuses on social phenomenon. This qualitative method examines social phenomena of people and groups (for example for the elderly, defining the problem and designing a better health care system, issues of aging and the workplace) and tries to interpret the meaning behind human activities (Given, 2008). Charmaz (2006) states that qualitative methodologies aim to collect data about people in their natural environment during specified time frames. In the context of design research, qualitative ethnographic research methods are the most frequently used to explain the targeted user phenomenon. First, the characteristic of qualitative research is contextual (Gray, 2014, p.161). The focus of this approach is to construct social reality through the eyes of the researcher. Qualitative research is used when the researcher attempts to explain, describe and interpret the social phenomenon (Leedy and Ormrod, 2001, pp.136–137). Moreover, the researcher can use this strategy to gain new insights into the concerns regarding Thai diabetic children. From the study of various methodologies, the ethnographic qualitative approach was selected as the most appropriate methodology to help to find answers to the research questions discussed in Chapter 1.

Ethnography is one of the qualitative traditions that aims to understand human groups, societies, communities and cultures. To gain insights into specific groups, researchers have to put themselves into the participants' setting. Previously, ethnography was considered as long-term fieldwork research but nowadays ethnography is conducted in a much shorter time frame[55] due to the limitation of timescale and budgetary limitation. 'Unlike, experimental research, ethnographers should not try to control what happens in their field situation' (Madden, 2010, pp.16–17). In terms of practice research, ethnography is conducted in the field by involvement in a particular group. Five methods are frequently used when conducting this tradition: observation, field note observation, information and conversation interview, cultural prob[55] and visual research (Reeves et al., 2008, p.513: Rose, 2012, pp. 297–327). Muratovski summarises that there are five procedures to conduct ethnographic research: 1) select the group of

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[55] A 'cultural probe' is defined as a collection of 'evacuative tasks' to get some fragmentary clues about the subject's life and thought processes (Gavner et al., 2008).

participants, 2) determine the site of participants, 3) access to the group's leader 4) access to the group of participants through their leader, 5) being a participant and 6) identifying the findings (Muratovski, 2016).

4.1.4 Phenomenology

In addition, phenomenology was used as the methodology to study the selected participants and to reflect their experiences of being a Thai diabetic child. Leedy and Ormrod (2001) state that unique and exceptional participants must be used to investigate the phenomenon in depth over a specific time period. For this study, the time period the year of 2014 to 2018, and occurred in a consistent setting, such as in the patient's house or in the Bangkok Children Hospital. Analysis was done from a phenomenological approach.

Phenomenology is one of the qualitative approaches that seeks out the understanding of the target group through their perspective of the same situation (Leedy and Ormrod, 2001, p. 108). This means the phenomenology can be used to gain an insight into how participants experience the same product and same situation. According to Lester (1999), many methods can be used in the phenomenology tradition, such as observation, focus groups and in-depth interviews. Lester also emphasises that the in-depth-interview is the main method used in the phenomenology tradition.The quantity of participants range from five to twenty-five (Laverty, 2003, p.18). To support this information, the participants should be diverse, to provide rich information from the unique stories of each participant's situation and experience. The main question this tradition seeks to answer is 'How do the participants experience things?'

Three factors which differentiate between phenomenology and ethnography are important for this research. First, phenomenology aims to understand the participant's experience and their perspective toward the same situation. Phenomenology allows the researcher to understand an individual's first-person perspective of a particular experience, whereas ethnography focuses more on a collectivistic perspective of the participants in the same culture. Secondly, in the ethnographic approach, the researcher has to place themselves into the participants setting to gain insights on the particular group or culture. In the phenomenological perspective, a number of methods can be used to interpret the participant's thoughts and their perspective. Third, the type of research question that leads the researcher to conduct the research through the tradition of ethnography and phenomenology is different. Research that investigates 'why' and 'how' questions is commonly used in ethnography. This also guides the researcher to select the participant in his or her natural setting. Contrast this with the type of research

question in phenomenology, which focuses on the meaning of participant's thoughts and perspectives of their unique experience.

This research aims to understand diabetic children of ages five to six years, as well as how to make a meaningful gamified experience for this age. The first research question is to determine nursing strategies, and to interpret this phenomenon. In-depth interviews were conducted to understand diabetic children's personal coping experience. Phenomenology is one of the most practical methods to understand a personal patient from a first-person perspective, as well as that of his or her family's experience with type-1 diabetes; all participants share common problems with type-1 diabetes. All of these selected methods will be explained in detail in the collecting data section.

```
┌─────────────────────┐              ┌─────────────────────┐
│  Coping strategies  │              │ Meaningful gamified │
│                     │              │     experience      │
└─────────────────────┘              └─────────────────────┘
           │                                    │
┌─────────────────────┐              ┌─────────────────────┐
│    Phenomenology    │              │     Ethnography     │
└─────────────────────┘              └─────────────────────┘
           │                                    │
┌─────────────────────┐              ┌─────────────────────┐
│  In-depth interview │              │     Observation     │
└─────────────────────┘              └─────────────────────┘
                                                │
                                     ┌─────────────────────┐
                                     │    Questionnaire    │
                                     └─────────────────────┘
                                                │
                                     ┌─────────────────────┐
                                     │     Focus Group     │
                                     └─────────────────────┘
                                                │
                                     ┌─────────────────────┐
                                     │   Drawing activity  │
                                     └─────────────────────┘
```
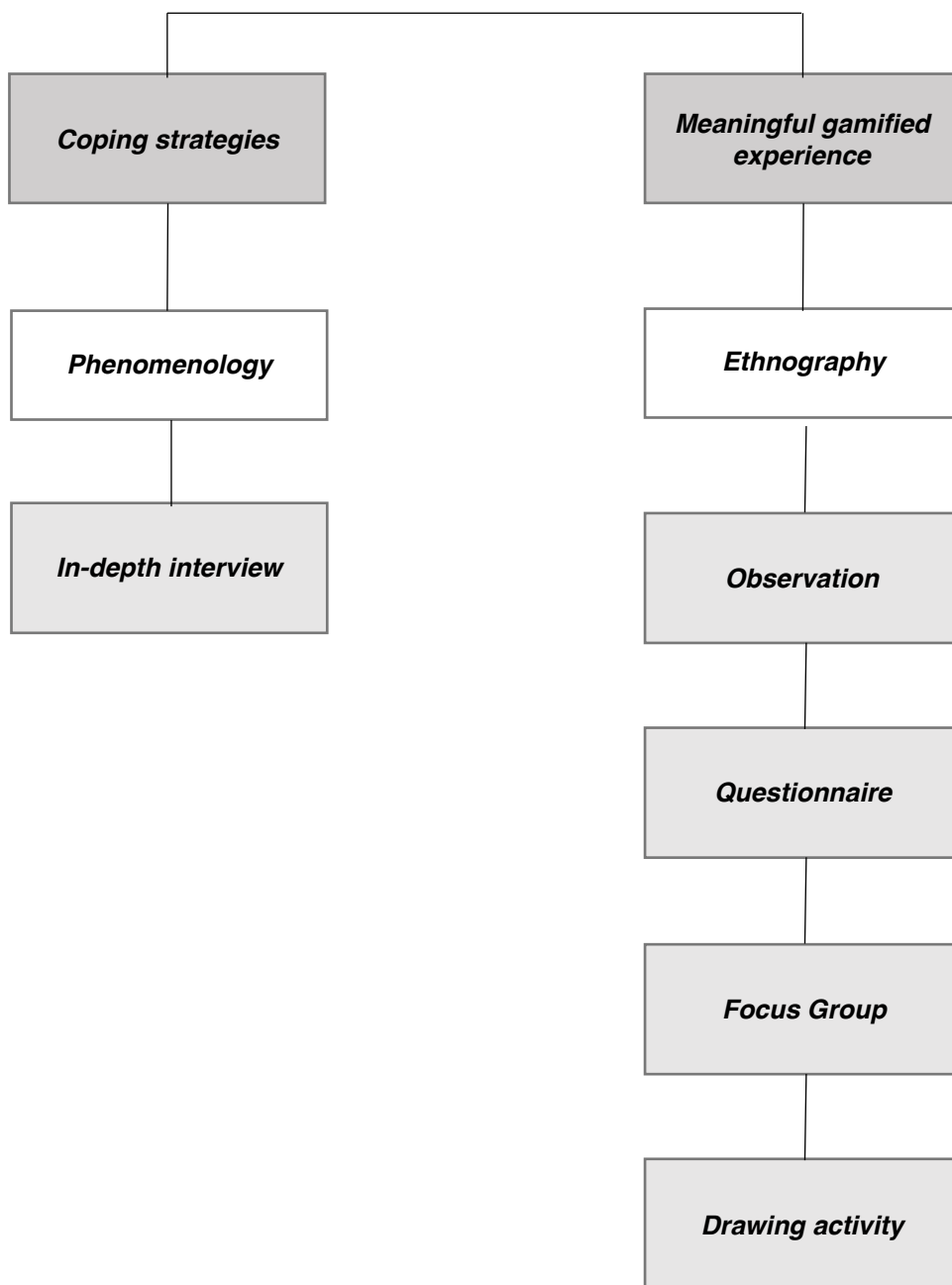
Figure 4.5 The diagram of methods in used this study (Klangpremjit, V., 2019)

4.2 Methodological Process

Related research on the use of games for holistic health care services have been studied to identify the gap in research and to market serious games for children with type-1 diabetes. To simplify, the methodology used here came from the following process, as seen in Image 4.6.

```
┌─────────────────────────────────────┐
│         Literature Review           │
└─────────────────────────────────────┘
                   │
┌─────────────────────────────────────┐
│   Research question and objectives   │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│        Develop model concept        │
└─────────────────────────────────────┘
                   │
                   ▼
┌─────────────────────────────────────┐
│         Research fieldwork          │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│             Test design             │
└─────────────────────────────────────┘
                   │
                   ▼
┌─────────────────────────────────────┐
│            Final design             │
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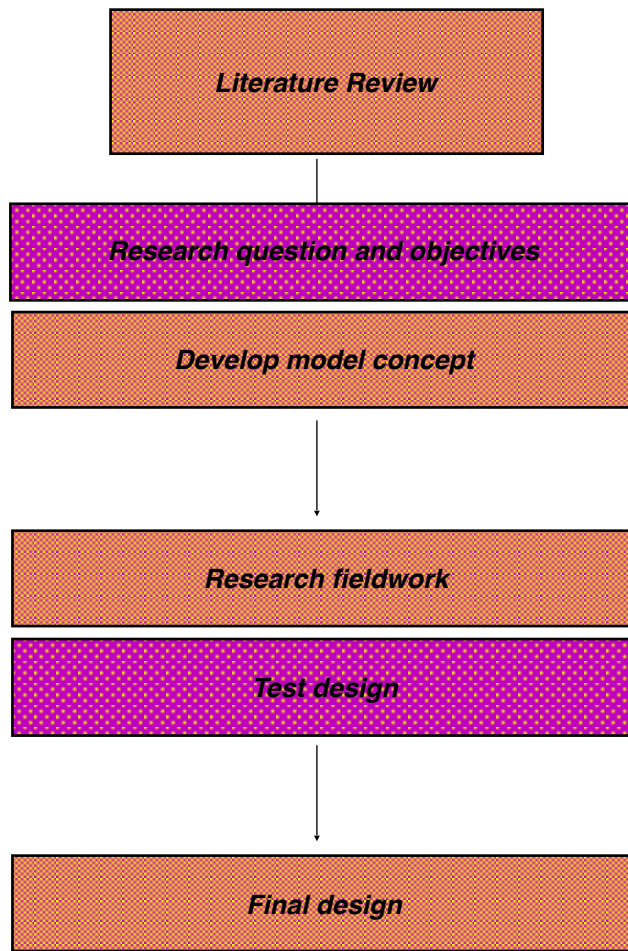
Figure 4.6 *Diagram of the research procedures in this study (Klangpremjit, V., 2019)*

The initial motivation for this doctoral study was to research design game intervention and to design the first Thai serious game for Thai diabetic children ages five to six years, which is necessary to 'develop a model concept process'. After the development of the model concept, fieldwork could be conducted to investigate the patients' experiences in their treatment regime. With insights gained from studying the nursing strategies used and developing a meaningful gamified experience for the children, the initial serious game could emerge from the collation of all information obtained in field research. Subsequently, the design testing process began, and then feedback from participants could be gathered to develop the final design.

4.2.1 Research activities based on the objectives

The step-by-step activities of the research in practice were:

1) Develop IS to uncover the medical information for the coping strategies for diabetic children, appropriate to the target group (Thai type-1 diabetic children ages five to six years).

- Develop a hierarchy of coping strategies information structured in a way appropriate for children ages five to six years;
- Identify problems of coping strategies of children with type-1 diabetes to define the content of IS;
- Develop a storyline that fits with the medical information to promote immersion for the children and the nursing diabetic data.

2) Design a demo of the software application, by using game design thinking to develop appropriate learning activities that motivate the children to cope with their type-1 diabetic condition.

- Investigate the content that could engage the target grouping in this intervention;
- Identify the capability of children at ages five to six years, in terms of operating the game system;
- Demonstrate a model of how behaviour change can be constructed through a gamified experience

3) Design an interactive computing platform, in cooperation with caregivers, child and teacher.

- Generate content of serious games to meet caregivers' expectations;
- Gather the requirements from the caregivers, and their expectations of the data from the child's medical regime in daily life, such as real-time updated sugar levels, and frequency of insulin administration during school;
- Generate an interactive tool that updates a child's status in the system for the caregivers to review.

Methods in used	Literature Review	System Development	Interview	Focus Group	Observation	Survey Questionnaire	Drawing Activity
Develop information system to instruct medical information of coping strategies for diabetic child in which appropriate to the target group (Thai type-1 diabetic children at ages 5 –6 years).							
Develop a hierarchy of coping strategies information structured in a way appropriate for children ages 5 –6 years	X	X	X				
Identify problems of coping strategies of children with type-1 diabetes to define the content of IS	X		X			X	
Develop a storyline that fits with the medical information to promote immersion for the children, the nursing diabetic data	X			X	X	X	X
Design a demo of software application by using the games design thinking to promote learning activities and motivate children to cope with their type-1 diabetic condition.							
Investigate the content that could engage the target group ing this intervention	X			X	X	X	X
Identify the capability of the children at ages 5–6 years, in terms of operating the game system	X					X	X
Demonstrate a model of how behaviour change can be made through a gamified experience	X		X		X		
Design an interactive computing platform co-operated with caregivers, child and teacher.							
Generate content of the serious game to meet their caregivers' expectations	X		X			X	

Gather the requirements from the caregivers, and their expectations of the data from the child's medical regime in daily life, such as real-time updated sugar levels, and frequency of insulin administration during school	X		X			X	
Generate an interactive tool that updates a child's status in the system for the caregivers to review	X		X			X	

Table 4.2 *Methods adopted for each research activity (Klangpremjit, V., 2019)*

4.3 Data Collection

The purpose of this research was to find out what constitutes an effective gamified system to motivate children with type-1 diabetes and help them manage their condition. Data was collected by undertaking field research that involved the ethnographic method of using structured interviews, questionnaires, and observations. Thai diabetic and non-diabetic children ages five to six years were interviewed and observed.

According to the above-mentioned diagram, two model prototypes will be developed in this study and the fieldwork aimed at interpreting feedback from participating players will have to be conducted twice. The first iteration will target the understanding of the feedback with regard to effective design triggers lying within the games' systems – those that help to determine which parts of the game are engaging and which parts may be too daunting. The first model prototype will be tested with 20 healthy children in order to identify persuasive triggers and responsive interactions for children in this particular age group. This play-testing activity will allow the participating children to freely play the game across one day at the discretion of their school. The findings from the first prototype play-testing feedback will be used when developing the final prototype. The study will then test the final prototype with children suffering from with type-1 diabetes. They will be able to spend one month playing the game and will report their progress as the final form of feedback in this project.

The rationale behind dividing the project into two parts was that the study has a limited timeframe into which will need to be fitted the understanding of the fieldwork data, analysing the data, designing the first prototype based on fieldwork data, play-testing the first prototype, analysing the play-testing feedback, designing the final prototype, and the data interpretation regarding the final design feedback. Based on this, to make it

fit the time scale of this study, separating the model prototypes to respond to each strand of research questions, and to harness the initial findings (meaningful and persuasive of serious games playing factors) into the final prototype, which will need a longer period to be tested by the diabetic participants (heuristic of a diabetes game concept), can deliver the expected outcome of this study.

4.3.1 Criteria for Selection of Participants

The first strand of this research was based on investigating the coping strategies of Thai diabetic children. The criteria for selection of participants to represent the target population was underpinned by four factors for consideration based on ethical considerations, time scale of the research, and the budgetary limitation. Firstly, diabetic child ages five to six years must be registered with a Thai diabetic organisation; Thai Hospital Foundation ethics and legal requirements were to be followed to conduct field research with child patients. Secondly, the participants and their families had to be accessible. Thirdly, the participants had to be willing to participate in the fieldwork, as it concerned examining the problems of the nursing intervention in coping with type-1 diabetes. Finally, the participants had to be coping with type-1 diabetes conditions themselves, rather than being solely the responsibility of the diabetes hospital; this meant that the problems of nursing type-1 diabetes had to be directly experienced by the participants. Five diabetic children and their families who were registered to the Bangkok hospital were selected to participate in the study by contacting their doctors. The study was conducted with the co-operation of each of the diabetic children, their parents and teachers. See page 313 in the Appendices for the consent forms.

The second strand of this research was undertaken to define what constitutes a meaningful gamified experience, in a Thai context, for children ages 5–6 years. For this strand, primary schools in Thailand were recruited based on the criteria. One class in each school was selected to study the children's behaviour and their interests in their daily school life. The criteria for selecting schools, focus groups, and interviewees fell into two main considerations: firstly, the school needed to be representative of Thai culture, as discussed in the Chapter 2, and secondly, the school had to contain a variety of children to reflect other children in Thailand. Five primary schools were selected to participate for the data collection, representing Thai children's general school behaviour and defining meaningful play experience of serious games for their ages. See page 313 in the Appendices for the consent forms and the list of participating schools, and teachers.

The final procedure of this study was to test the design of the game. This was to see how it motivated (or not) the diabetic child and in what ways it supported the child's treatment regime. The next chapter will discuss the selected schools in depth.

4.4 Methods

Participants with type-1 diabetes ages five to six years and their parents were recruited from the Bangkok Children Hospital, where they receive their health care services. This hospital was chosen as a place to recruit the participants because it is the central children's hospital in Thailand where a large number of diabetic children gather from all over the country. They were informed that their decision to participate or decline participation in this study would not adversely affect any relationship or treatments they received from the clinic. Three ethical consent documents—one for parental permission, one for their teacher's permission and an information sheet—were created and translated into Thai. The children were asked to discuss their participation with their parents before they decided whether or not to participate. The children's parents were asked to fill in a questionnaire, take part in an interview, and their child was observed (as explained below). Children were not required to sign the consent form, but their consent was recorded in the research record (p.308 in the Appendices).

4.4.1 Questionnaire

A qualitative approach was used to determine the attitudes of Thai caregivers to games. Due to the preliminary research findings, there seems to be a negative reputation for games in the Thai context, as almost all of Thai parents consider games as time-wasting and violent media. There are many current pieces of Thai research that demonstrate problems caused by game consumption for early age children, such as the social issues resulting from overload of playing games and a view that children neglect their education because of games. From this point of view, Thai caregivers have negative attitudes towards games, due to this poor reputation. Nonetheless, games also have a positive function as a motivational tool with benefits. Because of this, the questionnaire was composed to observe Thai parents. There were 3 steps for conducting the questionnaire for this research, which were; (1) designing the questionnaire; (2) sending out and collecting the questionnaire; and (3) conducting the resulting data analysis. The stage 3 data analysis is discussed in the next chapter.

The questionnaire was based on the literature review (p.12) and divided into 2 parts, which are; (1) characteristics of the participant; and (2) the parental attitude towards games. The first part of the questionnaire was aimed at understanding the personality of

the participants' demographic information, such as: their income, career, gender, ethnic and education background. This part aimed to examine and understand personality factors leading to intriguing findings, for instance, whether parents with a higher education are more open-minded towards games, or if the age of parents effects their decision to buy a game for their child. The second part of the questionnaire intended to find out how familiar parents were with the game content. This part of the enquiry allows them to disclose how frequently they play games and how they feel about them. The findings show the perspective of games through parental eyes, by defining their anticipation of an ideal game's characteristics.

To design these questions, participants were asked what would be an appropriate game content for their child, and what expectations they had for which game features were ideal for their child. This also included the parental perspective of how games influence the way children conceive the game's value and their own playing performance. Therefore, the questionnaire's questions were composed into 4 parts. Firstly, the participants were asked about their general background. Secondly, how long they permitted their child to play the game, which was a central issue in this part. Thirdly, the content of game design was discussed, allowing parents to fill in the open-ended question?. Lastly, space was provided for their opinions about creating games and the appropriateness of games for diabetes management for this age of children. Hence, four types of questions to answer the research questions were used: 1.) The frequency of occurrences, 2.) Checklist, 3.) Multiple choice and 4.) Dichotomy[56]. The questionnaire that was used for this study is provided in Appendix B (p.382), the questionnaire.

The questionnaire method was used to examine Thai parents' perspectives of digital game playing. Preliminary research findings showed the apparent negative reputation of games in Thai society. It is essential to find a satisfactory aspect of games from parents' or caregivers' perspective to design a serious game for children. Therefore, a questionnaire was prepared with the undersanding of Thai parents' perspectives and attitudes toward games. There were four steps in the questionnaire survey: 1) the process of designing the questionnaire, 2) sending and receiving questionnaires from participants, 3) questionnaire data analysis, and 4) questionnaire data synthesis.

The questions prepared were based on research questions and were used to obtain appropriate game content for children and to learn about parent's expectations from a game for a child of a particular age. This included parents' perspectives of the way games can influence children of a specific age (five to six years old). Therefore, the

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[56] A dichotomy gives a participant various options that represent the different concepts within a questionnaire, or those that give contrasting options.

questionnaire was divided into four parts. Firstly, participants were asked about their general background. Secondly, the way that parents allow their children to play games was queried. Thirdly, the desired content of the game design was queried using open-ended questions. Lastly, parents were asked for their opinion about creating a game and about appropriate game topics for children of the above age.

This data was synthesised by considering significant repetitive statements regarding the ideal content for persuasive games, approximate time of child's game play, and factors in the decision to buy a game. The analysed findings will be explained in section 5.2.6 (which deals with general findings regarding a meaningful game playing experience).

4.4.2 Interview

The phenomenological interview method was chosen to understand the problems that patients with type-1 diabetes experience. The aim was to study a group of children with type-1 diabetes and compare their different approaches to health management in their daily lives. It was necessary to design an interview that would investigate the individual patient's background and their routine or activities. Information about type-1 diabetes management, activities, shopping, meals, hospital visits, social life and electronic device use was collected. Problems experienced when using medical data, medical devices, clinical adherence, and managing their daily medical routine were also a focus. Table 4.9 illustrates the topics included in the interview. The data was collected by using the semi-structured interview, as it is flexible and allows the researcher to ask further questions in case of an unexpected answer.

Background, Life Themes and Incomes	Medical Information and Clinical Adherence
Education background Family background Life history Important relationships Resources	Medical information use and knowledge Friends and family communication Hospital communication
Everyday Activities and Recent Events	Medical Use
Events Life changes Work activities Domestic life	Knowledge about coping strategies

Table 4.3 *The topics covered in the semi-structured interview schedule (Klangpremjit, V., 2019)*

The first set of interviews was conducted in November 2015. The interviews were divided into two parts. The first part focused on information about the participants' daily life and how they managed their diabetes treatment. This part explored the daily life of type-1 diabetes patients in terms of the way they used medicine, their method of checking blood glucose, their eating patterns and family background. The second part focused on the use of technology, their attitude towards technology and new media, to inform the possibility of creating a technology that caters to their needs.

The interview started with questions about daily life and the problems experienced, e.g. complicated medical data. This was done to identify problems and solutions to make the clinical adherence experience better for the patients. Before commencing the interview, the aim of this research was explained to all the participants, and their parent. Only those who were willing to participate were selected and signed consent forms. Participants were also asked to refer people from their social network to be interviewed. Each interview was recorded on audiotape. The parent's and child's voices were recorded discussing gamification and how it could be a part of their child's diabetes management. Participants were given a copy of the questions prior to the interview (p.318, in the appendices). Parents took approximately one hour to complete a questionnaire about their child's medical regime, their general behaviour and the aspect of serious games for health care services. There was also a one-hour interview with the parents and child to discuss how the child manages his or her diabetes. This took place in a location convenient to the participants.

Additionally, in the strand of Additionally, in the strand of non-diabetic child's motives for playing games, the focus group interviews were conducted in a room provided by the school's officer. The procedure was similar to the interview conduction with type-1 diabetic children. A consent form was sent out. It contained information on the procedures to conduct and collect drawing activities, the confidential research information for collection for the fieldwork, and an ethics information sheet explaining to the headmaster that this activity would not affect the schoolchildren's learning and would not mentally harm the children (Appendix A). The participants were divided into nine groups: six groups of five-year-olds, and three groups of six-year-olds.

The children were recruited by schoolteachers based on the following requirements: (1) children's parental consent to participate, (2) their basic drawing ability, and (3) presentation skills sufficient to present their drawings. Participants were provided with a set of pictures, comic characters, cartoons, and other forms of children's media, such as toys and illustrated books. At the beginning of the focus group activity, the teacher was briefed about the questions (p.337). Two rationales were given for using the teacher as

the interviewer instead of the researcher: (1) if the children view the activity as a formal research activity this may lead to distorted answers because the children might give the answers they think they are supposed to give; (2) using a person the children are familiar with can help obtain the most accurate responses for the research; and (3) the teacher can use known techniques to motivate and encourage the children to participate.

The focus group activity considered significant factors that motivated players aged five to six to engage with the game playing activity. The questions were formulated through knowledge of the game's elements, based on relevant and basic persuasive game design principles (Chapter 2; Appendix 5.1.2, pp. 337-346). After conducting the focus group activity, qualitative content analysis, similar to that of the analysis method used for interview data, was conducted. N-Vivo[57] was used to organise the response data.

4.4.3 Observation

Parental and school officers' permission to observe children at school was obtained from the school official to study how the children manage their conditions at school. The observation took place in school for three hours during class, from 9am till lunchtime. The classroom teacher was informed that the observation would not disturb or intrude on the other students while the researcher was in the room. The observation would be in harmony with the classroom environment. Children were informed in such a way that they understood their own rights to decide whether they wished to participate or not.

Permission was requested to photograph or film the children's treatment regime at school, as this is an effective way to collect observational data, and all were told that the collected data would be kept securely and privately in a room provided by the participating school. The photographs and video recordings provided insights into the child's experiences with type-1 diabetes management. Pictures and video protection/ obscuring will be applied to protect the children's identity for the final submission. The observations will not contribute to increased surveillance or monitoring of children, and participants were assured of this before recording.

Three weeks were spent at the school (weekdays only) in November, 2015, conducting fieldwork and observations. The school chosen was Choke Chai Rangsit School in Bangkok, from 8am to 4pm each day. To assure the headmaster, an actual fieldwork plan had to be submitted in advance. The observation field notes were divided into four

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[57] 'N-Vivo' is a software created by the international company QSR to help researchers analyse and manipulate text-based qualitative data. The program was originally invented by Tom Richard in 1999 (Richard, 2003). The program can organise massive amounts of information and data which researchers categorise, group, and differentiate in order to build strong evidence to support their arguments and findings.

categories: 1) action, 2) objects, 2) insight and 4) themes. First, regarding action, the participants were observed in terms of what they did in their daily school life. The school's activities, namely, playing and learning activities, were examined in the field note observation. During the observation, initial notes were recorded in a diary, including the main ideas and keywords, as there was little time to take notes about each participant's behaviour in detail. while observing the participants. The activities of the children were categorised based on the following: daily school activities, playing activities, and learning activities. This made it easier to interpret the pattern of the activities in the children's daily routine. Secondly, the objects (for instance, toys and stationary) used by the participants were analysed to understand what they meant to each participant and how they used it. Understanding the relationship between humans and objects can provide an understanding of culture and the ways people use objects (Appadurai, 1986). In this study, the objects and the children were examined through the lens of Thai culture, aesthetics, and the children's interests, to gain in insights into the game system used here. Four aspects were used to analyse the relationship between the children and the objects in this study: objects used for learning activities, objects used for entertainment purpose, objects used for edutainment purpose, and daily products. Thirdly, all the field note observation data was summarised and categorised for easy revision.

The observation and field note-taking process was divided into four categories: (1) jotting down brief key words, (2) descriptions of everything related to the issues stated above, (3) reflection of what was learnt from the data, and (4) analysis of what was learnt from the reflection information. As indicated by the observation procedures mentioned above, significant activity and object performance data were noted down in a table based on three considerations (time, activities, and objects). Once the significant activities were noted, the data was revised and insights were obtained through deep immersion to find the meaning behind the activities and the relationship between participants and objects. The insights gained from this stage were noted and categorised into several themes, as shown in table 4.4. below. The table provides information on participants' activities in their school life, which were separated into 2-hour slots. In each 2-hour slot, information on children's activities and interactions with objects was placed in columns 2 and 3. Substantial insight was obtained from each activity and object, as summarised in column 4.

Time and Theme	Activities	Objects	Insight	Themes
8.00-10.00				
10.00-12.00				
12.00-14.00				
14.00-16.00				
16.00-17.00				

Table 4.4 *Example of observation report template (Klangpremjit, V., 2019)*

4.4.4 Drawing activity

In this study, the aim was to focus on the children's drawing as a method of communication, exploring the meaning within their drawing as evidence. According to Kress (2001), social semiotics emanate from the notion of the relationship between sign and the messages. This relation emphasises the fact that signs which appear in the drawing evidence are shaped by a variety of social process and its connections. Social context influences the manifestation of signs which lie within children's drawing (Kress, 2001). Using this method helped to facilitate the interpretation of an individual child's visual communication, as this visual method is a representation of their attitude on games and the relation to their culture.

Other rationales to support use of social semiotics in this study are that this method offers us flexible procedures. This technique also commonly used for the visual art research (Mullican, 2008), investigating optical media such as a poster, drawing, and painting to interpret the meaning of images. Used in contextual studies, this exhibits the evidence and knowledge that using visual drawing analysis as a tool can deliver aesthetic benefits to inspire children, enabling good co-operation and a willingness to participate.

To examine meaningful game playing signs through drawing evidence, 50 non-diabetic children were recruited for this study to participate in drawing activity, by dividing the children into five groups, three groups of five year olds, and two groups of six year old children. Each group was studied separately, based on the school's staff arrangements.

The participating children were allowed to bring pictures in which reminded them of an their ideal game. The drawing activity took place in the Chokchai Rangsit School, located in Bangkok. In the beginning, a consent form was sent to the schoolmaster. This consent form discussed the detailed information of fieldwork activities intended, how the drawing activities would be conducted, how many staff were required, how long the drawing activity would take, and the confirmation that the fieldwork activity would not disturb learning activity.

This drawing research activity was conducted on 8th December 2015. The 50 children aged five to six years old were provided with plain A4 paper to draw a game interface that they would enjoy designing for an ideal game, which reflected their interests. Once the drawings were collected, fifty of the drawings by participating children were analysed using the social semiotics method. The results of the drawing evidence will be addressed in the next following chapter (users research, p.100).

The drawing analysis process had four parts: 1) the content of children's drawings, 2) the people or objects shown in the drawings, 3) the implication behind the people and objects shown in the drawings, and 4) understanding the implications behind the drawings.

Two drawings were chosen to represent the processes used to interpret the signs in the children's drawings. The criteria for choosing the drawings was that the pictures should show a diversity of signs to make it easier to obtain a better understanding of how the drawing evidence analysis tool could be used to interpret the meaning behind the signs in children's drawings. Many drawings showed repetitive issues with regard to engaging in games. For instance, approximately half of the child participants depicted characters from 'Pokémon Go' in their drawings (N = 42). Furthermore, some drawings lacked signs depicting the meaning behind them. Examples of the children's drawings have been provided (see Appendix B-7, pp. 386-390). To interpret the meaning behind the children's drawings, the four-step approach to semiotic analysis of children's drawing by Kress and Van Leeuhan (1996) was used. This is one of the methods of analysis that is most related to the current study. The purpose of this method is to interpret children's drawings to understand the implications behind them. Kress identified the 4 steps of semiotic analysis as follows: 1) identify the signs, 2) isolate individual signs, 3) organise the signs, and 4) synthesise the child's perspective (Kress, 1996). Using the analysis method of '4-SASA'[58], the children's drawings were analysed by combining

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[58] '4-SASA' is the four-step approach of children's drawing analysis demonstrated by Kress and Van Leeuhan, aimed to interpret the meaning behind children's drawings. The principle was illustrated in their research (1996), Reading Images: The Grammar of Visual Design. They emphasise the systematic steps of children's drawing analysis as mentioned above.

their drawing evidence with transcripts of their conversations about the drawing process. The four-step approach to children's drawing analysis was used to understand children's perspective of the productivity of gamified experiences in their context. For the current research perspective, this method of drawing analysis allows game designers to investigate how children communicate their interests through their drawings.

Two categories of signs were interpreted: 1) the researcher's interpretation and 2) children's interpretation. To distinguish between children's and researcher's annotations, different coloured markers were used for each annotation (black and grey). In this step, the endeavor was to interpret the images based on the social semiotics methods[59] and the knowledge obtained from the literature and contextual review. From the social semiotic analysis perspective, this technique can be used to understand the culturally conventional representations in children's drawings, which reflect their thoughts, perspectives on games, and interests regarding persuasive games. For example, most of the children draw themselves and their families with smiling faces to depict an idealistic life where they are good boys or girls in a big family. This shows how family plays a big role in influencing children's thoughts. Children may even draw the sun to depict an outdoor lifestyle, comprising of joyful and cheerful activities. To clarify this type of drawing analysis, two examples of annotations were depicted. The images below show how   notes were taken on the children's drawings, to interpret each sign in their drawings before moving onto categorise the signs. The details of this drawing annotation method have been revealed in the images below, which provided further steps for decoding children's drawing into similar categories of signs and meanings, to represent meaningful game play through drawing evidence.

The images were interpreted to discover the content of the games the participants had designed. In this stage, participants were allowed to present their pictures. This included the story of their games and what the signs within the drawings were about. The information from the verbal presentation and their gestures was considered a complement to the drawings in this step. Why participants drew this content and how the content represented the participants' interests and thoughts was analysed. Understanding the elements and signs of each picture facilitated the interpretation of which game contents that participants were interested in, and how that motivated them to play it. Thirdly, the signs were scrutinised with regard to the meaning behind them. Some of the signs reflected participants' thoughts and their perspectives. This also

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[59] Social Semiotics methods refers to the methods which focus on understanding social behaviour and communication within specific settings or environment. This aimed to investigate the meaning behind people's communications and their behaviour through visual, non-verbal and verbal language. This method was originated by Ferdinand de Saussure (Thibault, 2004).

included the cultural content that influenced participants' thoughts and perspectives on games.

Studying the connotation of each sign suggests which features and contents can be integrated within a persuasive gamified experience for the children. The next step is consideration of other methods that participants used to clarify signs, such as colours, lines, and verbal presentation. The purpose of this section was to analysis the resulting data from the pictures in the drawing activity. Hence, to discuss organisation of signs within the children's drawings. Two examples of drawing analysis are depicted in Images 4.7 and 4.8 as follows.

Sign: 'Being a hero' symbolise as a human with the weapon to against the villain.

Signs: Upturned mouth in the charaters refers to the happiness of being a hero in the gamesphere

Due to the interview during the drawing process this character represents himself as the main character of the games wearing pink suit as it is the favorite colour of him.

Sign: The participant draw opened mount and wide circle eyes to represent the villain's face as it looks like a scary face in the participant perspective.

Use of the diffrent colour to saparate water and earth. The participant created the villain into two categories one is on the earth and the another one is under the water monster.

The content of this game is about protecting all of the flowers from the monster by creating the weapon to against them, if all the flowers gone, the game is over. The researcher assumes that the child adapted the idea from the famous game "Monster Garden" which he usually plays on the smartphone.

Signs: Upturned mouth into charaters refers to the happiness and also represents as a good characters in the game. From the interveiw data, this charater is to support him to power up so as to against the monster. This charaters was also created to be protected, if they are all destroyed, this means the game is over.

Sign: The weapon is used to represent the tool to protection and against the villain. In this image, there are two types of weapons; human made (cannon) and nature weapons alike (Rock and tree).

Sign: The participant drew the character gnarring with the power off its mouht represent of being a bad guy or the villain.

Figure 4.7 Example of child's drawing (Klangpremjit, V., 2019)

Signs: Upturned mouth in the characters refers to the happiness and joy in the gamesphere

Due to the interview during the drawing process this character represents herself as the main character of the games wearing blue and yellow skirt with a smily face.

Sign: The participant draw the table to represent having meal with the family instead of drawing food because of lacking of drawing skill.

Using the blue colour so as to represent the bright and cheerful word with the sun rise.

The content of this game is about cooking. The child told while she were drawing that this picture is about cooking with the familly which consists of parents and grandma, like her real life. She cannot draw food, so the table represents as a symbolic of food and meal.

Sign: A cooking hat was draw as a signature of cooking. In the image, the auntie character wearing a cooking hat as she told that auntie is the main character of the games as she cannot cook by herself.

Signs: Upturned mouth in the characters refers to the happiness and joy in the gamesphere

Signs: Upturned mouth into characters refers to the happiness and also represents as a good characters in the game. From the interview data, this character is her aunt as she is helping her to cook.

Sign: The participant wrrote under the image that this game is a cooking game.

Figure 4.8 *Another Example of child's drawing (Klangpremjit, V., 2019)*

4.4.5 After conducting the research

Here are steps taken in the data analysis of the field research activities discussed above

1) Transcribe the interview: The audio recording of the interview was transcribed and reviewed manually. All of the identifying information was removed, such as names of participants and their child, name of the clinic, and the name of the child's school. A pseudonym was used to identify the participants.

2) The data storage system: A storage system was devised and divided into two parts: 'paper-based data' and 'audio-based data'. The paper-based data was collected and locked away in a safe place, while the audio data was kept on a password-protected personal computer, accessible by the researcher only. The data will be kept in a safe place until the research has been published and stored safely for future research at UCA and elsewhere.

3) Accessing data: Only the researcher and the researcher's team (supervisors) will have access to the audio or video tape and questionnaire papers, which will only be used for educational purposes.

4) Disposal of data: When all of the data has been analysed, some parts relating to the problems of children with type-1 diabetes will still be retained, because the researcher may need the information to use as the basis for further publication, but the information from participants will be anonymised. This is to make sure that the research information is still retained, in case the researcher cannot find the participants again. The rest of the recorded data will be destroyed by shredding documents, reformatting the hard drive and erasing the audiotape.

5) Analysing data: The collected data was analysed manually.

4.5 The Use or Potential Benefits of the Study

There will be no direct benefit for children and parents in this research. The researcher cannot promise that this research could help the participants directly, but the knowledge gained from this study would help to increase the understanding of using gamification to help children with type-1 diabetes manage their condition. Research findings will help develop the concept of medical devices that could be used by children with type-1 diabetes to optimise their clinical adherence (coping with their diabetes) and their use of medical products, such as blood glucose monitors, insulin pumps and lancets. Designers may use gamification to create effective tools for children with type-1 diabetes. Other evidence has shown that using gamification as a tool for health promotion could improve patient experience.

4.6 Duration of the Project and Location

This study can be broken down into three main stages: (1) understanding users through the methods of qualitative fieldwork; (2) gaining initial insights from users' feedback on the initial game prototype; and (3) testing the final game prototype with type-1 diabetic children.

To interpret the diabetic children's requirements and to understand what motivates children of this specific age group, the study applied four methods of qualitative research.

First, interviews were conducted with 10 diabetic children and their caregivers. Next, focus group interviews with 90 non-diabetic children divided into ten groups were conducted. Next, a questionnaire was given to 100 caregivers where they were asked to make observations of their particular child both at school and at home. Finally, drawing activities were conducted with 50 non-diabetic children and ten diabetic children. After analysing the information from this fieldwork data, the insights based on two strands of the research will be applied to the design consideration for the first initial game within this project. This project tested the first game with 20 children through focus group interviews. After this, the developed version of game was tested on five diabetic children within one month.

The diagram below identifies the timeframe for this research, indicating the time period for each of the methods undertaken that were shown to be suitable for fitting into the timeline of this PhD study.

Research Methods		Research questions	Duration of the period	Place and location
Interviewing with 10 cases of diabetic children		Problems of coping strategies	10 days (a day per each diabetic child)	Diabetic child's house in Bangkok and suburban area.(Phatumtanee and Nakornpatom)
Focus group interviewing with 90 of non-diabetic children		Meaningful and persuasive serious games experiencing	4 days	5 Schools in Bangkok and sub urban area. (Phatumtanee and Nakornpatom)
Observing with a diabetic child		Problems of coping strategies	26 days	a School in Bangkok and sub urban area. (Phatumtanee and Nakornpatom)
Conducting questionnaire with 100 of caregivers of chid at ages five to six		Meaningful and persuasive serious games experiencing	a day for sending a letter and two day for collecting all letters	5 Schools in Bangkok and sub urban area. (Phatumtanee and Nakornpatom)
Conducting drawing activities with 50 of non-diabetic children		Meaningful and persuasive serious games experiencing	4 days	5 Schools in Bangkok and sub urban area. (Phatumtanee and Nakornpatom)
Analysing data		Design process	2 months	-
Designing		Design process	46 days	-
Back-end coding of Initial games		Design process	2 months	-
Focus group interviewing with 20 of non-diabetic children		Meaningful and persuasive serious games experiencing	3 days	5 Schools in Bangkok and sub urban area. (Phatumtanee and Nakornpatom)
Analysing data		Design process	2 months	-

Research Methods		Research questions	Duration of the period	Place and location
Designing		Design process	2 months	-
Back-end coding of final games		Design process	2 months	-
Interviewing with 5 cases of diabetic children and observing		Meaningful and persuasive diabetes health games experiencing	41 days	Diabetic child's house in Bangkok

Table 4.5 *List of research methods used based on the four components of the game system in this research (Klangpremjit, V., 2019)*

4.7 Conclusions

To approach the research goal and objectives, the appropriate methodology had to be applied, which was the qualitative approach. Various methodologies were explored that are commonly used in the design industry, which include phenomenological and ethnography. The main selection criteria for the methodology were the aims and objectives of this research, which included two main research questions: 1.) what constitutes a meaningful gamified experience for children at this age, and 2.) define the problems of coping strategies for children with type-1 diabetes at ages five to six years.

In this study, there were two main areas of knowledge which were needed to gain insights: problems associated with the coping strategies of the Thai diabetic child in their treatments regime, and the definition of a meaningful gamified experience for the Thai child aged 5–6 years. Considering the two main categories of research questions, the different traditions of qualitative approach to conduct research were selected for the two main questions. In summary, this research uses the multidisciplinary approach of the qualitative research tradition to investigate the research questions.

Chapter 5: User research

Interpretation of fieldwork data and data analysis

This chapter provides readers with synthesised information on the data from the research fieldwork, obtained through ethnographic methods, based on two strands of the research questions, discussed in the previous methodology chapter (p.65). The findings are divided into two subsections, in order to ascertain the features of the diabetes game, based on the participating children's and caregivers' requirements. This was to demonstrate the persuasive triggers of digital gameplay experiences for the five to six year old children studied. The aim in this chapter is to help establish the design guidelines for promoting productive outcomes for a type-1 diabetes game. This chapter has four subsections:

(1) Defining the characteristics of the participants;
(2) An analysis of the type-1 diabetic children and caregivers' requirements, obtained through the interview method;
(3) An analysis of the ethnographic methods used, regarding meaningful game play factors, within a Thai context, and analysis of the focus group interviews, observations, questionnaires with parents, and drawing activities;
(4) The emergence of design guidelines based on the fieldwork;
(5) A summary of the key findings

In the first three sections, the general findings regarding users' requirements and the productive play factors will be discussed alongside the numerical statistics, to affirm the number of stated issues by the participants. These two subsections will acknowledge the actual responses of the targeted users to the research questions in this study. Next, subsections 3 and 4 will explain how this data steered the definition of the game's design guidelines and criteria in this study.

5.1 Characteristics of the participants

As mentioned earlier, there are two strands of fieldwork. The first part was undertaken through semi-structured interviews with diabetic children and caregivers, whereas in the second part, observations of ninety non-diabetic children provided insights into persuasive game playing factors. Both the fieldwork sections took place in Bangkok, Thailand in 2014 and 2015.

In the first part, ten Thai diabetic children aged five to six and their carers, recruited with the help of doctors were interviewed in paediatric hospitals and schools located in both the urban and rural areas of Thailand. Six of the participants lived in central Bangkok, whereas the rest lived in rural areas. In the second section, one hundred non-diabetic children were separated into nine focus groups comprised of sixty five-year-old children and thirty six-year-old children. The table below classifies the number of participants in the interview. Ninety of the participating children were recruited from five different schools in Bangkok (N=3) and rural areas (N=2). The characteristics of the participating schools indicate how the children's characters were influenced by the school's environment, tendencies, and society.

	Males	*Females*	*Ages*
Diabetic children and caregivers	Children (N) = 4 Caregivers (N) = 1	Children (N) = 6 Caregivers (N) = 9	**5 years old (N) = 6** **6 years old (N) = 4**
Non-diabetic children	N = 47	N = 43	**5 years old (N) = 60** **6 years old (N) = 30**

Table 5.1 Number of participants in the study (Klangpremjit, V., 2019)

In this study, the selected schools contained children from middle-class families who could easily access digital devices and entertainment in the form of digital games. All of the ninety participating children were accustomed to watching popular cartoons and children's entertainment on television, the internet, and through physical publications, such as Disney and Sanrio[60].

Regarding the research questions that focused on the parental perspective of digital game playing for young children, one hundred Thai parents were asked to respond to questionnaires sent to them. There were ninety responses received. To characterise the participating Thai parents, five questions were asked about specific aspects: (1) gender, (2) average income, (3) educational background, (4) age, and (5) occupation. Based on the questionnaire data, 70% of the participating parents had middle-class incomes –

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[60] Sanrio is a Japanese company that designs and produces products and media about a number of cute characters using stories. The company is behind most of the well-known Japanese characters for children, such as Hello Kitty, Onegai, My Melody, and Cinnamoroll.

about 20,000–50,000 THB per month. Additionally, seventy-four of the questionnaire respondents were female. This indicated that the accessibility of digital game playing by young children, and whether or not the game design had an impact, was influenced by the parents' opinions. Further, it was discovered that the parents' ages and educational background affected their open-mindedness to digital game playing content. In addition, 64% of participating parents graduated with a bachelor's degree, 24% graduated from college, and 12% from high school. The average age of parents was between 35 and 50 years at the time of this research. Most of the participants were not familiar with the type of cutting-edge digital game technology that is currently flourishing.

In the next section, the general findings that emerged from the research questions will be discussed.

5.2 Analysis of type-1 diabetic children and caregivers' requirements through the interview method

This section examines data from twenty interviews with type-1 diabetic children and their caregivers (ten interviews were conducted with children and ten with caregivers). The social sciences categorisation software 'N-vivo' was used to systematically organise the interviews and conduct reliable management of qualitative data. This helped to examine the similarities and differences in identification of the coping requirements for type-1 diabetes for each participant exploring the game's system. When examining the connections and contradictions for each participant in terms of coping strategies in a Thai context, differences were revealed in the results between the game's discourse of archetypes identified by diabetic children, and the actual problems occurring in a specific Thai context.

5.2.1 General findings: diabetic Thai children & caregivers' experiences & problems

In this stage, the interview questions were separated into 4 categories: (1) the difficulties of learning to cope with type-1 diabetes conditions; (2) the problems of a type-1 diabetes management regime in everyday life; (3) the ability to do activities that rely on participants' physical conditions; and (4) the resulting recommendations and suggestions for diabetic health games and how to change digital game playing attitudes. The interview questions were found in the literature on the context of the problems of diabetic nursing strategies, including Polit et al. (2004), Morse and Ricards (2002), Burns and Groove (2001), Norman and Parker (1990), Laser and Folks Man (1984), Bricher (1999), and Hallet (1995), and these were discussed in the introduction (page

1). These studies helped to construct interview questions. Based on the four main sections mentioned above, the research questions (Appendix B-1, p.318) were used in the interview sessions to assess the interviewees' experience of coping with type-1 diabetes.

The participating interviewees offered sixteen different examples of strategies for how they dealt with diabetic daily life. The children, meanwhile, mentioned ten types of problems they experienced with their daily diabetic regime. Among the participating interviewees, 70% mentioned lack of social support as the biggest obstacle to coping with diabetes in daily life, such as the lack of regulations supporting diabetic children in school, the lack of information sources, and the lack of responsibility by school staff. Additionally, 53% of participants stated that understanding diabetes-related data is too difficult for children aged five to six years to manage, specifically, numerical data on insulin and carb intake. The third major problem experienced by 41% of participants was that they lacked the motivational drive to constantly manage their diabetes condition. Lastly, 37% participants responded that they were sometimes confused by the complex protocols of their conditions, such as remembering the expiry dates of insulin, taking note of what they have eaten, estimating insulin doses, and preparing equipment and food for the next school day.

Learning about diabetic coping strategies is imperative when a child has been newly diagnosed with type-1 diabetes. Regarding the difficulties of learning about coping information, every participant emphasised issues, such as the lack of educational tools and media providing appropriate instructions on coping for diabetic children of certain ages (five to six years old). The child participants (N = 10) were asked what particular strategies they used to learn to cope with type-1 diabetes. The main methods were receiving instructions from their personal doctor (70%), and searching for information on the internet (30%). Seven of the diabetic children stated that they were taught coping strategies by their doctors when they were newly diagnosed with type-1 diabetes. The rest the participants were not formally trained by a diabetic doctor, but learned through actual experience with caregivers instead. Due to the children's immature capabilities at this age, with regard to both physical development and mental development, it was reported that coping with type-1 diabetes was too difficult to comprehend in the early stage of their diagnosis. In particular, dealing with the intricacies of balancing insulin levels and food intake was considered crucial by most participants caregivers. Interestingly, learning from personal doctors was the only option mentioned by some participants. The educational tools that doctors and schools provide to newly diagnosed children is a manual containing coping conditions, as well as tutorials with the doctor. Eight diabetic children reported that the book was not interesting to read and that some

of the nursing data seemed too difficult to understand. When participants were asked why instructions were too difficult to understand, the answer was that large amounts of data was represented in the form of diagrams and tables, which confused and frustrated participants. One child reported that she was distracted by the amount of text and did not know where to start. Providing appropriate and comprehensible instructions on coping strategies for those with diabetes conditions was highlighted by participants' caregivers as being the most important element for achieving coping in daily life. Half of the participating caregivers confirmed that if their child comprehended the overall concept of coping strategies, (for instance, the appropriate insulin level and amount of food intake), this would reduce parents' anxiety and promote cooperation regarding coping activities (17%) for the children.

Regarding coping with diabetes activities in daily life, the lack of motivation was reported to be caused by doing repetitive coping activities over a long period. Some children stated that having to check glucose levels and perform insulin administration three times a day made them feel frustrated and embarrassed, especially when doing the latter in front of peers in school. It was found that only six-year-old children mentioned feeling embarrassed, whereas five-year-old children did not face this issue. The participating children indicated their boredom using seven different types of expressions: (1) running away, (2) crying, (3) becoming angry, (4) ignoring caregivers, (5) hiding, (6) playing around, and (7) zoning out.

Additionally, six of the participating caregivers stated that the insulin dosage and food for diabetic schoolchildren had to be exceedingly accurate and appropriate, because the children's health might be put at risk from erroneous insulin levels, caused by misused and improperly calibrated equipment. One child once took an expired insulin dosage during a school day, which put him in semi coma (a medium level of unconsciousness). Caregivers also stated that the quality of the insulin dose relies on the temperature and preservation technique, which must be carefully calibrated. This implies that there are many factors involved in making sure that children and caregivers fully comprehend coping information. Formal instruction provides them with concrete methods of coping, but the patient also gains knowledge through actual experiences. Thus, two categories emerged from the interview data regarding problems with diabetes regime: (1) children's lack of motivation to perform coping activities, and (2) the apprehension regarding accuracy of insulin dosage and carb intake. When asked specifically about the methods they have applied to tackle these problems, all participating caregivers stated that making precise notes in their diaries is the only effective option. Eight participants used physical notebooks to keep track of children's diabetes data, whereas two of them used mobile apps, such as 'Notes' and 'Reminders' on both iOS and Android. However,

participants noted the barriers in using mobile apps to organise type-1 diabetes data: inconsistency between diabetes tracking equipment and the programme used for data transfer, used to connect the glucose monitor and system (N = 4), forgetting to upload and update the data (N = 7), and difficulties of system usage (N = 6).

Another significant concern regarding daily diabetes management was the aspect of trust. All the participating caregivers mentioned their anxiety regarding school because the school staff seemed to lack the knowledge to cope with the children's condition. Four children mentioned that, to be accepted into school, their parents had to admit that the school would not take any responsibility for any diabetes risk that might occur. This highlights the aspect of lack of support from the school's staff and governing body. All participating caregivers had to cope with their child's regime by themselves during school hours. Based on the interview responses, only one school took responsibility for the children's diabetes regime. When asked about the approach to reducing caregiver anxiety and worry, regarding the child's school day, participants replied that the school staff had provided coping strategies and actively responded to the children's needs. One caregiver mentioned an intriguing notion: the concept of Thai manners. She said she did not want to bother the school staff because she was too courteous to do so. Based on this behaviour, the children's caregivers seemed to think that coping with diabetes conditions creates a reliance burden.

The last concept in this subsection deals with prohibitions caused by type-1 diabetes. Seven participating children stated that, in school, they could not fully participate in every type of activity, such as going camping and freely playing with their peers, which two children said that they were sometimes not allowed to do. This was confirmed by caregivers, who said that going camping means being highly prepared, in terms of insulin dosage and food. Many caregivers did not want to take the risk at all. One child said that his mother would not let him participate in some activities with friends, which made him feel isolated. When asked precisely what kind of activities they wanted to do that were prohibited by caregivers, the respondents mentioned going camping, eating the food their peers (non-diabetic children) ate, and playing after school hours. It was discovered that more than half of the participating caregivers (N = 7) worried about their child playing with peers. This parental belief contradicts the notion that doing physical activities can promote emotional and physical wellbeing of children with type-1 diabetes (Territory of Organisation of Diabetes Australia, 2009; American Diabetes Association, 2003). The caregivers also discussed different aspects of the prohibition of physical play with peers: (1) feeling out of control (70%); (2) feeling afraid the child will get hurt (50%); (3) wanting to avoid taking risks (30%); (4) thinking it is a waste of time (20%); (5) worrying about its effectiveness with ketone

levels (10%); (6) worrying if children will have too much fun to quit and its effect on diabetes symptoms (10%). Additionally, non-diabetic children sometimes assumed that participating children receive privileges for being sick compared to other children, such as special food, snacks at any time in class, the freedom to visit caregivers during the school day, and the freedom to avoid participating in every school activity, as mentioned by three children. This implied that diabetic children's peers and teachers have an insufficient comprehension of type-1 diabetes conditions, which can influence diabetic children's experience of coping with their condition in school and make them feel isolated from society.

General data was synthesised into seven clusters based on the problems diabetic children and their caregivers' experience, through the content analysis method. Through content analysis, similarities and contradictions were compiled for each participant's significant statements, in order to formulate the overarching themes from the research. Eight themes were developed in this section: (1) the lack of support from school facilities; (2) the lack of appropriate information sources; (3) the lack of opportunities to apply knowledge to reality; (4) the lack of motivation; (5) the lack of trust; (6) the frustration with repetitive coping activities; (7) the feeling of isolation from society; and (8) difficulties in comprehending the diabetes coping strategies. The resulting data was visualised in the diagram below, based on the problems of type-1 diabetes children's coping strategies, demonstrating the relationship between the participating diabetic children's and their caregivers' responses. In Image 5.1 below, one can see that there are some problems that are shared by both the caregivers and diabetic children: 1) the lack of appropriate information sources, 2) the lack of application of diabetes knowledge to real situations, and 3) the difficulty of dealing with type-1 diabetes coping information. The problems of coping with diabetes can be categorised into two areas that most affect either the caregivers or the diabetic children.
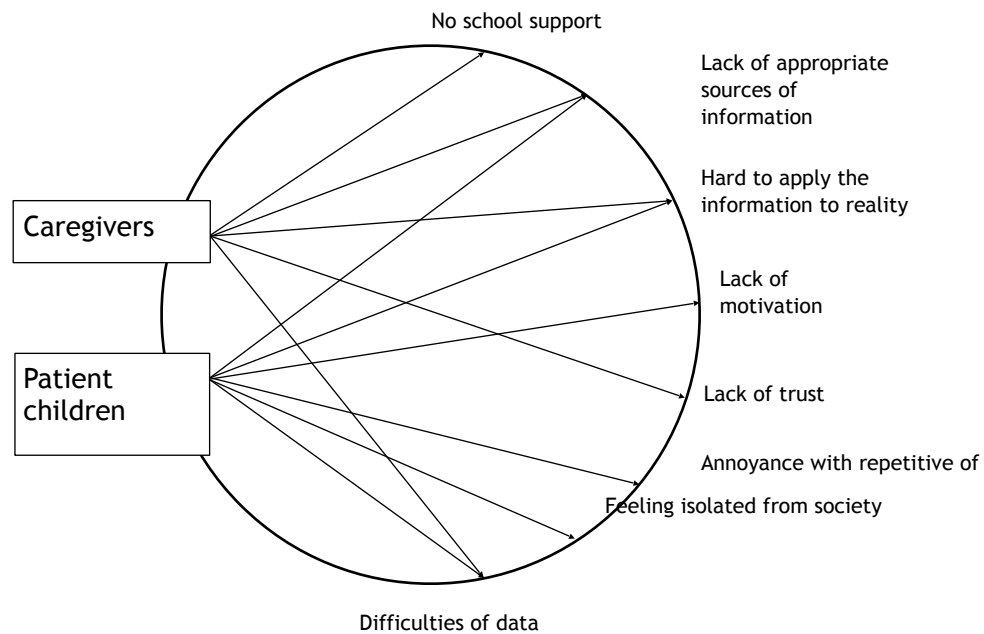
Figure 5.1 *Information reported by interviewees regarding the problems of coping with type-1 diabetes in the Thai context. (Klangpremjit, V., 2019)*

The second subsection, aims to define the features of a diabetes game for young players, based on the responses of participating caregivers and their diabetic children. Eight significant game features for a diabetes coping game were suggested by both caregivers and diabetic children for diabetic children aged five to six. During the interviews participants were asked in a straightforward manner about the features and game functions they would recommend for a diabetic game. The responses were as follows: (1) a mode for obtaining diabetic knowledge in real-life situations (50%), (2) an instructional mode, which is suitable for the developmental level and abilities of children aged between five and six years old (47%), (3) a feature showing diabetic children's data in daily life (76%), (4) a feature monitoring insulin and food intake based on answers given by caregivers (100%), (5) an information and organisational mode for counting carbohydrates, food intake and insulin levels (64%), (6) a feature to contact the diabetes' doctor (24%), (7) a feature giving non-diabetic friends a better understanding of type 1 diabetes, which could promote empathy between child patients and their peers (40%), and (8) a rewards system for diabetic children (60%). These suggested features constitute an ideal diabetes game, based on the problems experienced with an everyday type-1 diabetes regime.

The most frequently discussed features supporting caregivers and diabetic children were to supply them with easier methods to monitor glucose and ketone levels. Displaying the results of sugar and ketone levels as the end result of the daily treatment regime was an anticipated feature of the game's model. The caregivers stated that noting down such information in notebooks and memo programs could lead to mistakes and that there is a need for greater accuracy. This problem could be solved if such information is linked to reliable systems and is constantly reported to users; for instance, monitored sugar levels can be connected to the system, representing complete development of insulin levels throughout the day for the caregivers. Linking diabetic children's data was expected to reduce parental anxiety when the children are at school. Most of the participating caregivers suggested developing this feature to obtain updates in real time. When asked about the methods they used to update their child's diabetes data, almost all respondents said they had to go to the child's school to do it (N = 7), and some of them said they used the phone (N = 2). All caregivers emphasised the need for accessible functions that updated and reported the child's diabetic data, because this helps the child cope with diabetes in their daily routine. Additionally, the mode of diabetes data organisation refers to the mode that allows diabetic users and caregivers to take notes, arrange meetings with the doctor, reminds them about important issues, and reports their coping progression. A total of 67% of participants mentioned this feature as the second most important one to be added to the system. They stated that using this feature would help them deal with accuracy problems and would reduce errors caused by their negligence.

Rather than focusing on the data of type-1 diabetes management, participating caregivers and diabetic children proposed the idea of applying knowledge of coping conditions to real-life situations. For instance, two participants suggested that they could become better at counting carbs if they could practice with what they actually eat in their daily lives. All the participating diabetic children learned to count carbs and deal with imbalanced insulin levels and food intake through text-based instructions. The caregivers also stated that if diabetic children have a practice tool that can stimulate them through actual situations, this might enhance their ability to deal with unexpected situations in daily life (N = 10). Further, half of the participating children (N = 5) suggested a function that allows their teachers to obtain a basic understanding of diabetes conditions during school, which are: balancing insulin levels, selecting appropriate food choices and dealing with high and low sugar levels conditions. A few caregivers also suggested including a link to access the diabetes specialist directly (26%). They stated that this feature would allow them to reassure themselves when confronted with an unfamiliar situation. Additionally, the reward system aspect was repeatedly mentioned by the participants. The system would be intended to motivate child participants to be constantly mindful of their condition, with regard to frequency,

self-efficacy, and attitudes towards diabetes in specific contexts. When specifically questioned, all participants' definition of a rewards system referred to points, money, and badges.

The relationship between the caregivers' and their diabetic children's response to the anticipated and featured recommendations in diabetes games has been visualised below in Image 5.2 The suggested features have been divided into two sections: (1) caregivers and (2) diabetic children. The image reveals the following similarities in the suggested features: (1) practising knowledge in real-life situations; (2) appropriate information for a specific age group (five to six-year-old children); and (3) a rewards system.
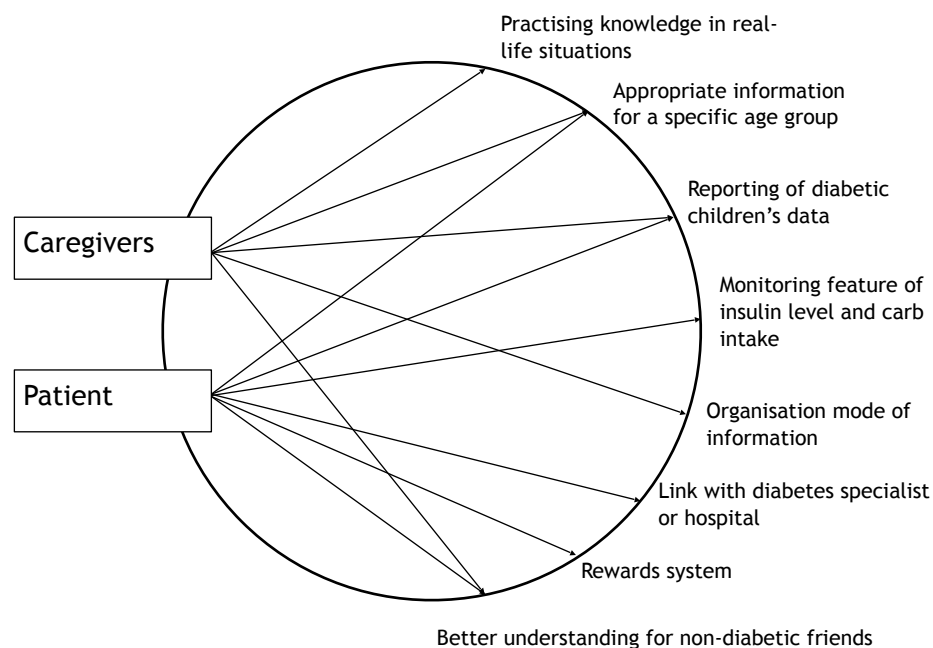
Figure 5.2 Interviewees' reported information regarding the problems of coping strategies among type-1 diabetics in the Thai context (Klangpremjit, V., 2019)

The above data has been used to define the diabetes game's features designed as part of this practice-based research. The rewards system feature was superficially mentioned by the participating diabetic children and caregivers, in the form of points, badges, and extrinsic rewards. As mentioned in chapter 2 (Contextual review), persuasive factors of the playing experience of diabetic health games are supposed to be maintained with both intrinsic and extrinsic components. This leads researchers to deeply investigate persuasive game elements, shaped by the players' environments and social contexts. To deliver targeted diabetic players with productive outcomes, the term 'meaningful game playing elements' will be explored in the following section.

5.3 Analysis of data on meaningful game play factors

This section showcases fieldwork methods and analyses the results in order to define persuasive, game playing factors to better design a diabetic game for Thai children. To achieve this, four methods were used during the fieldwork, and the similarities and contradictions of each method are considered. This section has four parts and relies on the following qualitative methods to explore one of the research questions (meaningful game play experience of specific players): (1) focus group interviews, (2) observations, (3) questionnaires with parents, (4) drawing activities, and (5) general findings of meaningful game experiences.

5.3.1 Focus group

Based on evidence from the focus group data, the findings from these methods can be divided into two main sections: (1) the data regarding their interests, and (2) the motivation behind the playing of games. In the first strand, data reveals that every participating child gave similar interesting information about content, regarding the content of the media they recently watched, interests, subjects, sports and video games. The result indicated that the content that was mentioned repeatedly consisted of the names of Japanese anime (N=76). Additionally, the answers regarding interesting content differed based on the gender of the participants. The research found that gender affects answers: girls report interests that are supposed to represent their ideal characteristic according to the thoughts of their parents, while boys showed more confidence in mentioning interests that might imply a negative personal characteristic; for instance, playing games, ignoring a school lesson and depicting names of violent movies. Archiving the interesting content of the children at this age was conducted through four questions: (1) activities that they were obsessed with recently, (2) content that was repetitively consumed, (3) the kind of media and games that they have recently watched or played, and (4) imaginary content that they would love to see in real life.

The participants revealed the types of activities that they recently engaged with: watching cartoons (N=90), sports (N=76), reading books (N=60), playing games (N=37), helping parents with the housework (N=14) and drawing (N=14). When asked about the rationales behind being involved in these sorts of activities, the answers given were: (1) because their friends are involved (N=84), (2) because it is fun (N=80), (3) because their siblings are involved (N=60), and (4) because they want to be good children (N=12). The significant data demonstrated that watching cartoons was the main entertainment source for children at this age.

Additionally, they also gave information about the media content and sort of activities that they had been recently engaged in: (1) Japanese anime (N=76), (2) those sports that they (the participants) had mastered (N=63), (3) 'Dreamworld'[61] and theme park content (N=40), and (4) scientific topics, which are wildlife, animals and space (N=57). The research asked the question that determined which media they had recently consumed and engaged in the most, and the answers were 'Pokémon' (N=75), 'Cartoon Network'[62] (N=12), 'Minecraft' (N=80), 'Frozen'[63] (N=32), 'Realm of Valour' (N=40), and 'Cookie Run' (N=34). To explore the children's playing motives, they were asked about what they would do if they had the chance to do anything they wanted in their life, and the answers were: (1) to have the ability to fly (N=74), (2) to be able to travel anywhere in the world (N=70), (3) to have many friends (N=69), (4) to be able to please everyone (N=65), (5) to be rich, which allows them to buy anything they want (N=64) and (6) to be a master in every field (N=42).

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[61] Dreamworld is an amusement park in Thailand located in the north of Bangkok.

[62] 'Cartoon Network is an American pay-television channel owned by Warner Brothers; the channel broadcasts a number of famous cartoons and animation films that target children between the ages of 7 and 15.

[63] Frozen is an animated film produced by Disney in 2013. The story is about a journey of a snow princess with ice power, exploring the world to find her sister. The story reflects the princess's courage through the journey's obstacles.

Time	Name	Significant Statement	Description	Analytical Categories
2.16	*Srivipa*	'I want to show my parents that I did really hard work and I got really good in maths'.	She is a little shy when she speaks, and her voice shakes while speaking.	**Parental expectations**
2.23	*Nida*	'My favourite one is "Cooking Mama" because I can create my own dish, and the Mama in the game is so cute'.	-	**Showing creativity non-heroic content**
3.40	*Nico*	'Pokémon is a really cool game. I love the way I collect monsters and compete with my friends. I feel like I am a master when I can conquer them'.	When he was speaking, the other students seemed to agree with him about the Pokémon game being their most favourite.	**Social impact**
4.45	*Benze*	'I don't really play the game because it is prohibited in my family'.	The way he speaks is not confident.	**Good person stereotypes**
4.54	*Lory*	'I wish I could help my mom to manage the housework'.	He uses his body language to support his statements.	**Good person stereotypes**
6.78	*Thanin*	'I want to be the first in every aspect of my life (study, sports, game, etc.)'.	He uses his body language to support his statements.	**Parental expectations**
8.97	*Pakorn*	'My favourite one is "Cooking mama" because I can create my own dish, and the Mama in the game is so cute'.	-	**Showing creativity non-heroic content**

Table 5.2 Focus group data - analysed based on main theme (Klangpremjit, V., 2019)

5.3.2 Observation

In the observation method, this study categorises observational data into two main sections: (1) the relation between child and object, and (2) daily activities. This project considered users' patterns in behaviour that demonstrate a set of activities in a real-life context.

Firstly, with regards to the relationship between child and object, based on the categorised data of observational methods, a few types of products were observed in this study that were relevant to entertainment: toys, electronic devices and books. The findings showed that outdoor toys that mimic the shape and form of buildings such as

castles, houses and farmhouses held the most attraction for children. It was obvious that during the routine of the school day, the children tended to play with their peers rather than playing by themselves. Some intriguing data arose whereby the boys played with the castles and the girls played with the houses. In addition, there was a difference in playing between boys and girls, reflected through the style of toys, colour and visual representation. Boys were attracted to the more violent types of toys and those whose style was boyish, such as robots and weapons. The study also found that role playing had been applied in most of the objects for the children at this age, such as being a princess and being a warrior.

The research also considered the objects that appealed to them when they were not playing with their peers; all of the participants tended to play with their smartphones. This reveals that almost all six-year-old children owned their own phone, whereas children aged five years old did not. In addition, most of the children played on their phone after the school day while they were waiting for their parents to collect them, and the objects in the form of education media, including games, books and educational toys, were mostly designed through role-playing content.

Secondly, regarding children's activities, the study exhibits that, in Thailand, the children at this age underwent similar activities each day, even in different schools. The research found that children were required to participate in national respect activities every morning, including the singing of the Thai national song, meditation and being taught about ethics. The importance of good personal characteristics and being a part of the nation were repetitively introduced into the lives of the children in their daily school routines. Additionally, observing the classroom activities reveals that the children had also been taught this content in each subject, particularly in Thai language classes. For instance, most of the lessons in the Thai language textbook contained the story that implies the role of royalty in Thailand through an exemplified set of situations. The table below demonstrates the categorised data that was synthesised into the insight clusters, which will be discussed in the following section.

Time and Theme	Activities	Objects	Insight	Themes
8.00-10.00	Learning activities: 1) Children start school by paying respect to the nation and singing the national anthem. 2) Students are taught to dance to a song about the sunrise. 3) Students are taught about good behaviour. 4) Maths starts at 9.30. Students learn how to add and subtract and learn about complex numbers. Playing activities: Before doing national respect activities, children are allowed to play freely on the playground for around 1 hour.	Before doing national school activities, children are allowed to play on the playground. The playground toys they play with are the toy castle and cave.	Nation plays a big role in children's school life. This is an activity they have to repeat every day before class.	**1) National influence** **2) Religious influence** **3) Being a good person**
10.00-12.00	After maths classes, logic, social responsibility, and the Thai language are taught.	Using stationary.	After maths classes, logic, social responsibility, and the Thai language are taught.	**1) Basic knowledge of academic issues** **2) Being a good person**
12.00-14.00	Children have lunch with omelette and cabbage soup with minced pork. Children pray and give thanks to everyone who provided them with food. This is an activity which happens every day before a meal. In the afternoon, children study English for an hour and a half. The teacher teaches them to sing a song about how to say 'welcome' in English.	Using stationary. Teachers use some edutainment tools such as video and musical instruments to teach students how to sing.	Children are taught to feel thankful to the person who provides them with food. This teaches them to stay humble. Using the other method to teach the children.	**1) Being a good person** **2) Social activity**
14.00-16.00	After maths classes, logic, social responsibility, and the Thai language are taught.	Using stationary. Teachers use edutainment tools such as video and musical instruments to teach students how to sing.	After maths classes, logic, social responsibility, and the Thai language are taught.	**1) National influence** **2) Religious influence** **3) Being a good person**
16.00-17.00	After maths classes, logic, social responsibility, and the Thai language are taught.	After maths classes, logic, social responsibility, and the Thai language are taught.	After maths classes, logic, social responsibility, and the Thai language are taught.	**1) National influence** **2) Religious influence** **3) Being a good person**

Table 5.3 Observation data - analysed based on main theme (Klangpremjit, V., 2019)

5.3.3 Drawing activities

An interpretation of the children's drawings exhibits implications regarding the meaningfulness of games user interfaces and the signs that indicate the persuasive factors. This stage determined to analyse the children's drawings into two main aspects: the signs that inform their personal interests, and the signs that indicate the appealing games' interfaces. The research found that most of the drawing evidence represents existing games and cartoons (N=64) and depicts social content (N=62), such as the drawing of themselves fighting the villain with their peers and drawing themselves as part of a group. An interesting finding was that all of the participating boys illustrated some form of battle between themselves and their opponents (in the form of monsters and aliens) (N=40), while girls designed their games as a role-play simulation close to reality, such as being a chef (N=24), opening their business (N=13) and dressing up (N=4).

After analysing the drawing data, the research summed up the content of their drawing evidence: (1) redesigning the existing games, for instance 'Minecraft', 'Snake', 'Cookie Run' and 'Pokémon Go!' (N=24), (2) drawing games as a platform to show their creativity (N=12), (3) designing games that represent their own life (N=10), (4) demonstrating fighting content (N=40), and (5) virtual pets (N=60). Additionally, the drawings also exhibited a set of signs that identify the games design interface: (1) games' avatar life bar (N=23) and (2) indication of scores and awards (N=10).

5.3.4 Questionnaire

Interpretation of the questionnaire data reveals insights demonstrating Thai parents' perspectives on the purchasing decision regarding digital games and helps to generate the games' content that is aimed at promoting a good understanding in parental eyes. Four main sections are embedded: (1) characteristics of the participating parents, (2) the content of an ideal game, (3) characteristics of an ideal game, and (4) preferred platform as well as access time for the child.

Almost all of the questionnaires were answered by females (N=84). Additionally, nearly all of the responses from caregivers indicated that they have potential to access any kind of digital technology for entertainment and educational purposes, especially for their child (N=80), as they mentioned that they permitted the child to play digital games once a day. When asked specifically to mention the name and type of games that their child had recently played, most of them stated that they were not aware of what kind of games the child was playing (N=77). In cases where the parent knew what their child had recently played, the answers were farming content (N=3), 'Pokémon Go'(N=6),

cooking content (N=1) and 'Candy Crush'[64] (N=3). In addition, the questionnaire asked specifically about the platforms on which children commonly play, and 67% of parents named tablets and mobile phones, whereas 24% named desktop and laptop platforms, on which children played PC games.

To identify appropriate content for a game that, ideally, the parents expect their child to play, the answers given were: (1) games that promote the child's cognitive development, such as puzzles and role playing (N=72), (2) games that amplify a child's creativity, such as Lego and simulation, and (3) games that represent content relevant to school textbooks (N=73). Additionally, the questionnaire data also demonstrated the rationales behind buying digital games: (1) the content of games that is appropriate for children of this age (N=90), (2) games that support both cognitive and emotional development (N=82), (3) games that support physical development (N= 40), (4) games that promote social activity between peers (N=64), (5) games of good quality in terms of production such as quality of graphic display (N=34); and (6) games that are not too expensive (N=41).

5.3.5 General findings regarding meaningful game play experiences

This part of the ethnography methods results offers insights based on significant and afore-mentioned data by participating children. When using each method, participants revealed their game playing motives using different expressions. Once this data was analysed, it was found that most of the statements regarding digital game playing motivations could be harnessed and categorised into one cluster of shared ideas about game playing motives in this research context.

Significant statements were synthesised from the analysis process, and it was discovered that there were thirteen themes that shared similarities and concerns regarding the participating children based on each method. For instance, the idea of being important in the surrounding society was repeatedly stated in different expressions, both verbally and physically (e.g. playing behaviours, drawing evidence and body language), such as (1) maintaining family bonds, holding each other's hand within the drawing evidence; (2) shouting loudly to get attention from peers, while playing outdoors; (3) informing children by Thai society that obtaining good grades will please their parents. This information has been visualised, in the chart below (Image 5.3), to demonstrate the percentage of play motives, informed by the participating

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[64] Candy Crush saga is a Match 3 puzzle game based, designed and developed by the British game company King (2008). The game is operated on both iOS and Android via mobile platforms. The game allows the player to match three similar icons to gain tokens, which allows them to unlock stages throughout the fantasy candy world.

children. Moreover, the diagram also shows the similarities and contradictions between the two genders regarding game play motivation, using different colour tones.
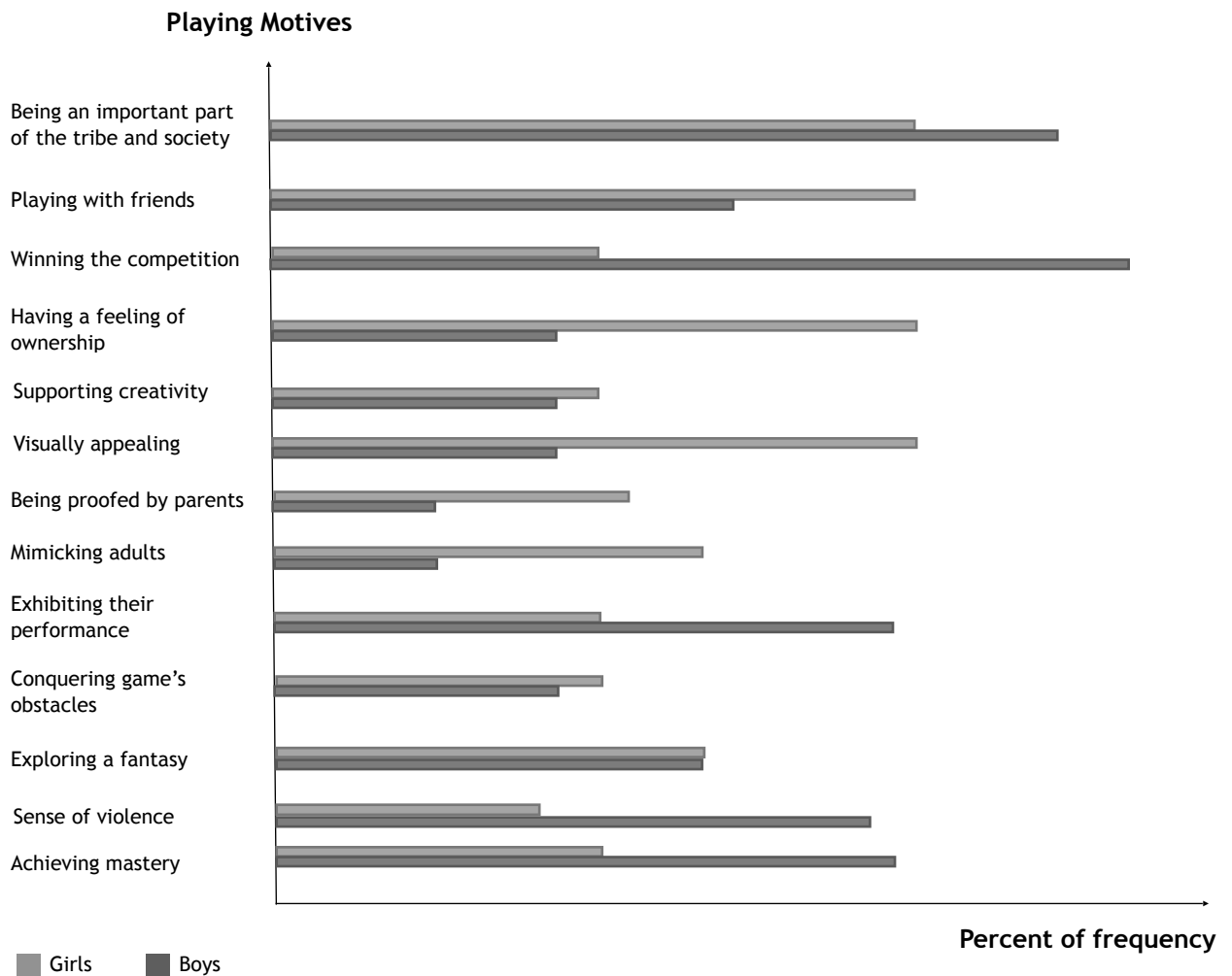
Playing Motives

Figure 5.3 The components of idealistic and meaningful games defined by the participants (Klangpremjit, V., 2019)

Based on this graph, interviewees' information about the motives behind their game playing can be divided into three main clusters: (1) prosocial game play interaction, (2) feeling of accomplishment; and (3) notion of escapism. These three clusters provide us with the core motivational drives behind playing digital games, specifically designed for young Thai players, using the three ethnographic traditions (focus group, observation, and drawing activity). The questionnaire data was used to identify the best type of games for young children. They were analysed based on the relevant concepts to aid the development of the design criteria, discussed in the next step.

Cluster 1: Prosocial game playing behaviours

The first cluster is prosocial game play interaction. In this study, the term 'prosocial behaviour' was defined by Penner et al. (2005, p.336), who stated that human behaviours involve broad actions that are influenced by surrounding contexts defined by a significant portion of society to perform actions that are advantageous to others. The concept of prosocial game play interaction was taken from participants' responses with regard to representing 'good person' stereotypes and the concept of the 'perfect self", as the foundation of interaction of play behaviour within the game world. This cluster consisted of the concepts of: (1) being an important part of the tribe and society, (2) sharing good experiences with friends, (3) being praised by parents, and (4) the paradox of violence in children media. The content of prosocial media plays a role in Thai children's behaviours through several platforms, such as textbooks, television, and games from an early age. This concept emphasises content of astonishingly strong moral overtones for this specific audience, depicting a collaborative scene and the 'right' behaviour in an ideal society. This cluster focuses on the interaction of game playing behaviour within the studied group and highlights the concept of being associated with charitably caring and altruistic personalities.

The idea of being important in society was represented in the data using each method. The evidence of this notion based on participants' verbal and non-verbal data obtained from different key ideas was individually analysed. Almost all the participating children (N=84) indicated that the feeling of being an important part of their society has a vital role in their motives for play, as they can share gaming abilities and support each other's avatar within the games world. More importantly, the children stated that they might feel isolated in reality if they did not share common interests with their peers. When asked specifically about the ideas that make them feel connected to and important in society, participants' responses provided an opportunity for them to share their influence and altruistic personalities. Moreover, this notion was also found in the children's drawings with consistency regarding multiple characters contained within these images. Participants explained that their characters were being supportive of their peers to conquer any obstacles, tasks, and enemies within the game's world. This related to the observation that young Thai children mostly played the following games, which are: (1) Pokémon Go! (iOS and Android); (2) Realm of Valour[65] (iOS and Android); and (3)

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[65] Realm of Valour (ROV) is a 'Multi Online Battle Arena'-style game , that is, a multi-player online battle arena or real-time strategy game created by Garena, a Singapore-based games company (Garena RoV Thailand, 2016).

Ragnarok[66] (PC, iOS, and Android). These games share similarities in gaming mechanisms, which highlight the co-operative motive between each player as a supportive part of a tribe, rather than as standalone leading player.

The concept of co-operative game play in these games allowed players to choose virtual characters to support players' tribes within the game. Based on this game function, the player will not be able to achieve the game's mission by playing separately from peers. For instance, being a priest (the game's character career) in the most popular game in Thailand, Ragnarok, will restrict the player from attacking monsters. The game's character progresses by playing missions with partners. This type of supportive play commonly appears in the form of two main concepts: 'buff' and 'healing'; buff indicates the action where the player uses his or her skill to enhance and boost team members' abilities, whereas healing refers to actions that reduce a team member's damage while being attacked by the game's villains. Despite being restricted in standalone gameplay, more than half of the participating children admitted that playing supportively is one of the main rationales motivating them to play in the first place. The concept of buff and healing reveals the importance of prosocial pattern behaviours within a game, through the associated ideas of charitable caring and selfless behaviour. The insight obtained in this section is that thoughtful Thai children are driven by a social context that prioritises being an important part of the tribe as the main game playing motive. This notion also underlines the expectations from society that centres on self-optimisation, reflecting the notion that being considered negatively as 'vain' is a strong factor of avoidance of a game playing role.

Another prospect that indicated the importance of prosocial behaviour regarding game playing, was parents' worry and truth about the existence of latent violence. Based on the questionnaire data (Appendix B), it was noticed that almost all of the parents allowed their children to play digital games that were relevant to educational issues (N = 73). The reflection of parental confirmation was demonstrated through the societal pursuits of hard studying, seniority, and obeying the rules, which were represented through the answers from the open-ended section of the questionnaire. Parental expectations play a vital role in the decision about whether to buy digital games and the opportunities of access to game play by young children. Based on the questionnaire data, the parents revealed the periods within the day when they allowed their children to play digital games. Most parents indicated that their children were usually allowed to

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[66] Ragnarok Online is a multiplayer online game produced by the Korean game company Gravity and released in 2002. The game allows players to interact with each other via a 3D environment that supports play fighting, such as pitting players vs the environment, guild vs guild, players vs monsters, and specific scenarios in different locations (Metacritic, CBS, 2018).

play games for an average of an hour-and-a-half per day after school (N = 80). It was also noted that the parents' responses did not reveal the names of the games their children were recently playing. Rather, the parents identified the game's overall concepts instead. The concepts mostly mentioned by the participating parents were sports and puzzle games. It was useful to obtain parents' perspectives on digital game , because it provided creative ideas for game play design. This, along with the participants' characteristics, implied that most of the participating parents were born in a time when digital games were not popular, thus, they cannot relate to them. Some parents also revealed their suspicions about the harm caused by digital game playing.

In spite of parental concerns regarding violent content in digital games for young children, it was discovered that almost all children's responses (N = 64) regarding their playing motivations acknowledged games' violent content. For instance, the participants, predominantly male, mentioned the idea of using weapons and conquering opponent's objects and territories. There was a contradiction between the findings of the interview and observation data. First, the children admitted that they did not have any interest in violent content because of the negative reputation of such games in Thailand. However, it was observed that children did in fact play violent games and that such games were popular games (e.g. ROV and Ragnarok). This contradiction revealed the vital role of prosocial characteristics in game representations within Thai society. Responding to the interview questions, participants revealed truly authentic motives for playing violent games, which presumably led them to be ridiculed and separated from the interview. Based on these findings, children were specifically asked about attractive factors that can replace violent content in games, and the children responded that competitions with other players could be a substitute (N = 47). By concealing their interest in engaging with a sense of ferocity in games, child players showed that they were concerned about their image of being a good person in other people's eyes.

Cluster 2: The concept of inciting a sense of accomplishment
In this study, a sense of accomplishment from playing digital games was defined through children's verbal data and drawing evidence, which was comprised of four different subsections: (1) the state of being a winner, (2) achieving mastery, (3) the feeling of ownership, and (4) showing their game progression and creative outcomes. The goal of being acknowledged as a winner was repeatedly found in drawings in the form of signs that represented the state of winning, in any form of competition. It was also found that leaderboard graphic elements had been drawn to reflect this concept. This finding was also supported by the interview data, which exposed the correlation of winning and being a part of a tribe. Most participants preferred to win games' tasks through team playing rather than as individual players.

Achieving mastery was done through the signs of scoring, representative badges, and obtaining limited wearable items. This was obvious in the drawing evidence, found in numeric elements and score labels (N = 23). The participating children were informed that to be a master the player had to achieve sufficient rewards, scores, tokens and rare items. Further, the desire to unlock the game's stages and levels encouraged participants to keep playing. Some of them mentioned 'Candy Crush'[67] (IOS and Android, 2010), an archetype of a successfully designed game with levels that unlocked as the player progresses. Players monitor other players' progression and the unlocked levels verify players' abilities, progress, and mastery. Thus, the research found a relation between mastery and a sense of ownership through the paradigm of the game's mechanisms. The participating children stated that the feeling of accomplishment can be driven by the rewards system, leaderboards, and unlocked levels and game territories, and by obtaining rare items within the game's world.

Almost all the participants raised the idea of possessing virtual objects during the interview (N = 58) and drawing evidence (N = 60) stages. This feeling of ownership was mentioned repeatedly through statements that highlighted the idea of the representativeness of social embodiment via anticipation of a virtual world. The participants responded straightforwardly that gaining rare items provides them with fulfilment of this achievement and allows them to represent their mastery of skill and gain peers' attention. It was noticed that there were similarities between this concept and the notion of escapism, the latter which will be discussed in the next subsection. Ideas that inform the children's feeling of belonging will also be explored later in this subsection. When asked specifically what types of game triggers give player this drive, the answers could be categorised into two sections separated by gender. Boys responded to this subject through the concept of empowerment (N = 29). This result was formulated from the frequency of the children mentioning attainment of powerful weapons or armour, unlocking supremacy, as well as maintaining and expanding the game's territory. Girls' responses mostly gave precedence to a sense of caring (N = 34). This was narrated through repetitive statements and signs about feeding, dressing up, and customisation. These gender differences are possibly the results of each gender demonstrating expected societal gender norms. This highlights how digitised data generation, referring to a sociometrical approach between the players and the game's system, is itself the product of social interactions.

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[67] Candy Crush saga is a match three puzzle game based, designed, and developed by the British game company, King (2008). The game is operated on both iOS and Android via mobile platforms. The game allows the player to match three similar icons to gain tokens, which allows them to unlock stages throughout the fantasy candy world.

Superficially, gender has a place in epitomising the sense of ownership that lies within the pleasure factors of a child at this particular age (Rudmin, F., 1994). However, there are shared common conventions to other aspects of daily life in this sense, which are a sense of nurture in virtual belongings and virtual self-pampering. The concept of nurture identified by participating children reveals that the player can monitor and look after the virtual object's[68] development as a game play progression, whereas virtual self-pampering refers to the player's ability to customise, decorate, and increase efficacy to the objects, those that depend on play performance. To conclude, players' motives regarding a sense of belonging that stimulates the feeling of accomplishment can be captured through participants' reports, which indicates that feelings of possession can emerge from games' modification mode, monitoring development of virtual objects, and the representation of the game play progression. These insights were supported by the participants' exemplification of these type of games, which are: virtual pets, simulation of town construction (i.e. SimCity[69] and Animal Crossing[70]), simulation of virtual life (i.e. The Sims), and adventure games (i.e. Pokémon Go and Animal Crossing). Based on the understanding of these games, provided by participants, it was noticed that the games' characteristics reinforce the rationale of ownership triggers, which have been mentioned above.

Lastly, by showing the game's progress and player's creative outcomes, the fieldwork data reveals that most of the participants' motives are exhibited by their gaming outcomes. This was supported by their specific responses in identifying elements that urge such feelings, exhibited by the completed stages and levels, skills attained, their avatar's various attire, and designed objects in games. The element of demonstrating creativity was supported through the fieldwork data which highlighted that the participants repeatedly mentioned customisation tools and decoration modes within game systems. They also precisely stated the rationale of this trigger desire, which was that participants' creative outcomes tend to be appreciated by other players and surrounding people (N = 64), which was a strong motivator to be creative. This was also amplified by participants' list of games that offer them such accomplishments, such as

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[68] A virtual object in this research refers to object that will be achieved by performing game activities such as wining tasks, conquering other players, and buying any type of game's rewards. This refers to virtual objects such as weapons, costumes, powers, virtual pets, cities, towns, cooking recipes, player's avatars, and game territories.

[69] SimCity (1986–2014) is a popular simulation game designed and developed by EA Games. The game allows players to build and customise their town and fill it with a virtual population. Players earn rewards when the population pays taxes and starts trading within the game's world.

[70] Animal Crossing is a popular simulation game designed and developed by Nintendo and designed by Katsuya Eguchi. The game allows players to build and customise their town and fill it with a virtual population, as same as SimCity.

Minecraft[71] (2012, PC and console platforms), Cooking Mama[72] (2008, console platforms), and The Sims (2004–2018, PC and console platforms). Based on this result, these important elements were considered as essential game design stages in this research.

Cluster 3: The concept of escapism

In the last cluster on the notion of escapism, four concepts were explored in the following subsections: (1) creating support for creativity and imagination; (2) creating attractive and visually appealing interfaces; (3) delivering role-playing content; and (4) enabling explorations of a virtual world. This cluster focused on ideas that indicate the importance of escaping from reality into the game's world. This notion relates to discourses on the epitome of the ideal game with the aim being that players are avoiding the daunting reality of life (Hellström, et al., 2012; Ryan, R., 2011; Chou, Y., 2012; Calleja, G., 2010; Yee, N., 2007). To clarify this concept, escapism is mentioned as a motivation, in which playing games allows the player to escape from the seriousness of day-to-day thinking about reality. Games are considered as an intervention and create a space that enables the player to freely perform and carry out actions within a virtual world, which they cannot do in real life.

An argument was made in this study as one of the key provocations, about whether the idea of escapism was mentioned repeatedly by participating children, based on the concept behind this cluster, that game's content can aggravate young children with this sense of motivation. When asked specifically about what promotes this feeling, participants responded that providing players with opportunities to defer from or to escape their real-life, motivates them in the first place. The participants also drew relevant ideas of unrelated, realistic content in their interview responses, which included: fighting, cooking, war, space exploration, imitating adults' careers, gardening, being a hero, constructing a place or city, and narrating a fairy-tale. The four subsections mentioned above demonstrate the frequency of participants' answers regarding elements provoking the sensation of escapism for five to six year old players.

Support for creativity and development of players' imagination was identified through the interview responses, which show that child players tend to exhibit their gaming progress through the outcomes of their creativity. Observing children playing at schools

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[71] Minecraft is a simulation game designed by Markus Persson (2009) and developed by Mojang (2011). The game allows the player to crate their empires through the form of 3-D square boxes. The ability to create a virtual world depends on rewards gained from mini-quest challenges and story-line tasks.

[72] Cooking Mama is a Japanese cooking game that allows players to create their recipes through the simulation of cooking action, for instance, grating, stirring and cutting. It was designed and developed by Office Create and published by Majesco Entertainment in 2006.

revealed that the most common toy for both genders was Lego. Lego aims to motivate children's imagination by letting them create any tangible form they desire. Additionally, through the drawing evidence interpretations, the repetitive implications of their creativity and imaginary outcomes, was demonstrated through their signs of customisation tools, the various options of creating things, illustrative of the imaginary expanse of their young minds. Additionally, from the participating girls' perspective, their creativity was represented through the idea of self-pampering. Referring to the sense in which they promoted their imagination of pampering themselves they drew various options for their games' avatar or even pets. Not only can the player's creativity be expressed through the virtual characters' entries, but it also indicated the character's status within the game world. In the fieldwork interviews, the participants discussed game features that could provoke this sense of demonstrating creative outcomes through different signs, such as: drawing, decorating, and building. Based on these responses, it was discovered that exhibiting players' creativity can express their imagination through the game system and demonstrates the relevance of escapism to them. There is a lack of opportunity in real life to do this, as well as to gain appreciation from surrounding people on one's individual creativity.

The concept of visual attractiveness is included in the cluster of escapism, which demonstrates that the game's aesthetic provides players with an illusory sensation. Based on fieldwork data, this idea was divided into three subsections of the games' aesthetic: (1) simplicity and (2) mood and tone that incite a sensitivity of the fantasy world, and (3) the impact of Japanese manga influence on Thai children's media. The participants characterised the simplicity concept using different expressions via drawing evidence and exemplifications of their favourite media (television, publication, and games). From these findings, simplicity referred to unrealistic and uncomplicated design elements. Four participants' favourite media were: 'Hello Kitty'[73] (N = 46), 'Pikachu'[74] (N = 75), 'Doraemon'[75] (N = 64), and 'Benten'[76] (N = 34). These were

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[73] 'Hello Kitty' is a Japanese cartoon character designed by Yuko Shimizu (1974) and developed by the Japanese company Sanrio. Hello Kitty combines the features of humans and cats, with a red bow on her ear and obviously no mount.? Hello Kitty became very popular around the world and was aimed at female audiences and children. She has appeared in various media platforms, such as, TV series, myriad lines of products, publications, and even theme parks.

[74] 'Pikachu' is a Pocket Monster (Pokémon). He is Japanese cartoon character licensed by The Pokémon Company. He is designed with yellow rodent-like characters with electrical powers. This character became famous after Pokémon Go was launched in 2016.

[75] 'Doremon' is a Japanese character designed and illustrated by Fujiko F. Fujiko as one of the characters in a manga series published in 1969. He is represented as a half cat and half robot figure from the future. This animation was noted to be one of the best-selling manga in the world.

[76] 'Benten' is an American cartoon character with the characteristics of a 10-year-old boy. He has the ability to turn himself into 10 different aliens to conquer his enemies. The cartoon was designed by Man of Action Studios and published by the Cartoon Network Studio in 2007.

disseminated through myriad platforms, including television (cartoon animation), publications (comic books, colouring books, and illustration books), and games (mobile games and games consoles). These examples share similarities with the lead characters' personas, which characterise their figures through simple human compositions. The lack of reality was reflected through steady lines and subtle elements that are observably seen in these cartoons' characteristics.

It was noted that the style of each cartoon also represents the concept of simplicity through modest elements. When asked specifically about the rationale behind their preferences in this style of character aesthetic, participants reported that the character leaves them with a sense of caring and empathy. It was concluded that this sense of simplicity represented through the popular children's media is correlated to the Japanese media's influence, as will be discussed in the following part. To immerse the child player within the sensitive fantasy aesthetic, participating children also discussed visual elements that they appreciated: use of vivid colours, magical elements, and distortion of reality objects, and mortal figures in the games' world. Based on these discoveries, it can be said that this fantasy aesthetic can be incorporated into the game system to provide an immersive play experience.

Regarding the characteristics of Japanese media for children, this aesthetic is mostly deemed as a representing artistic cuteness sometimes called the 'Kawaii' style, by participating children. This 'cuteness' was mentioned in the fieldwork results about participants' favourite cartoon characters and their attributes. At the time of this research (2014–2018), Japanese children's media has been broadly disseminated throughout the country through free television channels, whereas Western cartoons were mostly shown only on pay television channels. Based on observation method and focus group interviewing, the participants revealed that the rationale behind their attraction to Kawaii objects, which was the feeling of attachment and a fetishist relationship. As such, the style of cuteness influenced by Japanese media is usually visualised in the form of simplicity, round shapes, and the distortion of real-life human figures (i.e. big head, big eyes, and graceful body (Abe, 2015). Hence, the characteristics of Japanese cuteness in children's media can be summed up and seen through two strands: (1) intense concepts of childlike innocence and (2) easiness of recognisable shape (Abe, 2015). For instance, Hello-Kitty and Pikachu (as mentioned earlier) integrate the characteristics of Kawaii in their typical form: they are both tiny, powerless, simple figures, with plain colours and infant bodies. To summarise, this style of graphic expression is correlated to the idea of escapism that is provoked in young players with transitional virtual objects (Belk, 2013). This refers to the use of cute characters as an interrelated virtual object between their reality and the player's imagination.

Additionally, considering the idea of the impersonation of other roles, being a superhero is one of the important revelations of this subsection. The results indicate that participants generally rated themselves and their superheroes as high indicators of prosocial behaviour (N = 47). The idea of being a superhero is common among young children. From the fieldwork, it was observed that the concept of being a superhero was mentioned by participants with the societal aspiration of the perfect self. As discussed in the section above on prosocial playing behaviours (p.118), through the lens of the prosocial representative the archetype of a superhero was often mentioned. Hence, the characteristics of participants' superheroes imposed a sense of social burden for players, as popular and public figures in modern fictional media. However, it was discovered that the superhero ideal was not as frequently cited by female participants (N = 7). The girls' representation of role-model were more realistic, taking responsibility for the family instead of doing imaginative role-play as a powerful superhero. Meanwhile, the boys who preferred superheroes as the prevailing stereotypes felt that it gave them immense responsibility.

Additionally, participants mentioned adult role-playing in their verbal and non-verbal responses. Adult role-playing was reflected through career simulation, family role-playing, and simulating adulthood situations. Participants also stated that television media influences ignited their interest in the concept of being mature. Forty seven percent of participating children mentioned that Thai soap operas and television programmes influenced them about the concept of an ideal life. Participants stated that the concept of adulthood can invoke feelings of wanting to escape from their daunting future reality, such as the schools' day activities. The expression of mimicking adults was found in this fieldwork when observing: playground activities, the contents of popular games, and popular media. Girls represented adult content in the form of family role-playing (84%), cooking (76%), dressing up (82%) and career simulation (73%). Meanwhile, boys represented the idea of being adults in career simulation (90%), good guys and bad guys (i.e. police officers and robbers; heroes and villains) (64%), and last, role-playing from movies and animations (43%). These are dramatic results, showing that Thailand is still a very sexist society and that very traditional gender roles are still being affirmed in society and all media, but also that popular media and games are not demonstrating a wider range of role models for girls and boys that are not so gender regimented. These results relate to the norms that digital games are more suited to boys (Vaughter et al., 1992). Additionally, the games that are targeted at girls still reflect stereotypical concepts of girlhood, echoed in graphic representation (in the form of using pink colour schemes, delicate elements and an abundance of graceful ornaments), games' content (for instance, cooking, dressing up and puzzle games) and a lack of evidence of a female as an independent and strong character (Kondrat, X., 2015). This

indicates through the data that using narrative games was much more common for boys than for girls (Wright, S., 2007). However, this reveals that career issues are a common element that share the same characteristic of pleasurable play for both genders.

Finally, with regard to exploring the virtual world, this study's results demonstrate that most of the participating children mentioned that an important part of game play was about escaping into a virtual world (N = 60). Some of participants quoted 'Minecraft'[77] (2014, PC and console platform) as an ideal game that allows them to explore an imaginary and fantasy world. The participants' rationale to support their pleasure of exploring the virtual world was divided into three concepts: (1) to immerse themselves in the world that they will not be able to explore in reality (N = 46); (2) to avoid their daunting school life routines (N = 34); and (3) to enhance their problem-solving skills (N = 5). The participants were also questioned directly about the elements that urge them to explore the game's world. The answers were (1) the world's aesthetic (64%); (2) story-line narration (54%); and (3) to see the game characters' avatars (27%). From the fieldwork results, associations were found between the aspects of exploring the game world, and the feeling of accomplishment. This informed the way in which exploring games' world gives player a feeling of accomplishment.

Based on these three clusters of gamified experiences, insights were gained to support the main factors to make a productive diabetes game for children of a specific age. These findings will be combined with those requirements of participating diabetic children and their caregivers', as mentioned in section 5.1 of this chapter, pages 100-102. The next section will demonstrate how these insights will be incorporated into the game's structure to formulate the design guidelines for a diabetic health game.

5.4 The emergence of design guidelines

Diabetic children's and caregivers' requirements and players' motives were interpreted to help formulate the initial game design criteria. First, these findings were encapsulated into a few clusters with regards to the design considerations. Ostensibly, this section will provide a better understanding of how this data can be integrated into the final new diabetic game design guidelines, derived from participants' responses. The initial game design was defined by the participating children's and caregivers' requirements. This also exposed how the Thai sociocultural milieu has shaped players' attitudes and game

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[77] Minecraft is a simulation game designed by Markus Persson (2009) and developed by the Mojang Game Company (2011). The game allows the player to create their empires using a 3-D square box. The ability to create their virtual world depends on rewards gained from mini-quest challenges and story-line tasks.

playing interactions, through clusters of pro-social gameplay behaviour, inciting a sense of achievement and escapism. The knowledge obtained from the field work has in turn informed the design of the initial version of the diabetes game.
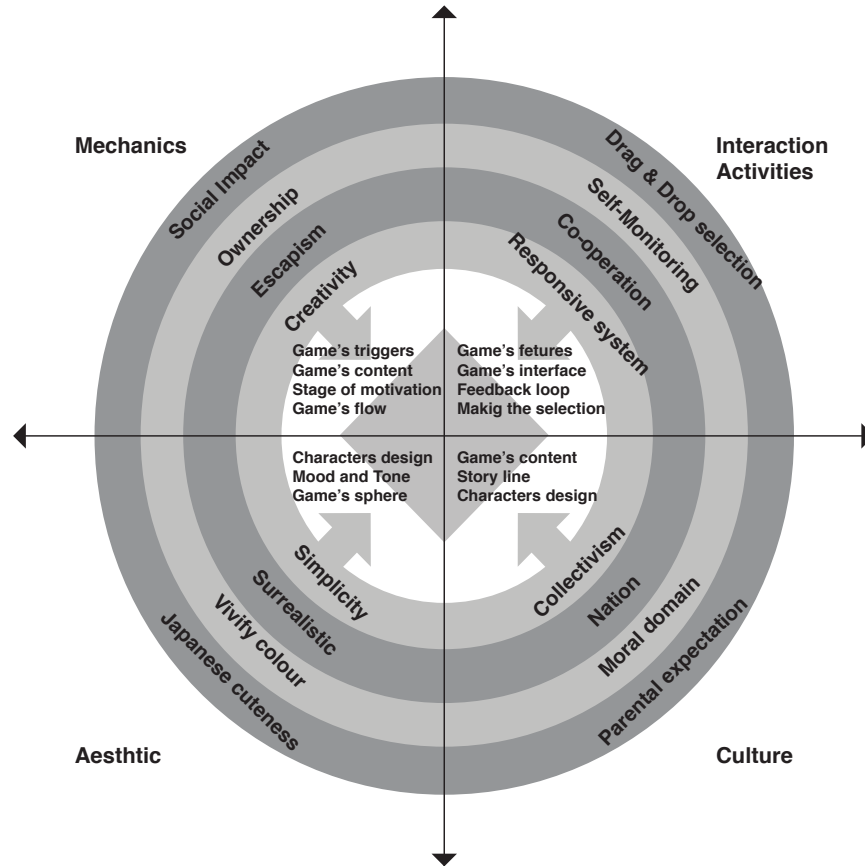
Figure 5.4 The matrix diagram used to generate ideas for the diabetes game's design guidelines I(Klangpremjit, V., 2019)

This diagram demonstrates how the research results have been analysed and the outcomes have been considered and implemented into each element of the game system. The game's architecture has consisted of the game's mechanics, interaction activities, aesthetics, and playing culture examined in this study, which were determined as core ingredients of game design considerations. Based on the clusters developed from the fieldwork, ideas that influenced the design of each game's elements were sorted into each of the game's standpoint elements. The awareness of prosocial behaviour, the sense of achievement and escapism helped to define the game's mechanics. To clarify, the game's mechanics consisted of the game's storyline, content, rules, the game flow, and triggers of player's emotions. These clusters helped to formulate the design criteria driven by these notions. For instance, the concept of teamwork co-operation helped to create the function that allows players to choose their roles at the beginning of game play. The details of the game's design process and how these playing motives will play a

part in the design criteria will be explained in the next chapter (Chapter 6: Design Research).

In the strand of interaction activities, results from the diabetic children and their families' requirements were used to identify functions that can be contained within an initial game. From the diagram above, four features were found to be key in the game design: (1) learning with type-1 diabetes coping instructions; (2) a mode for practicing diabetes strategies in real-life situations; (3) features that promote cooperation tasks between diabetic children and caregivers; and (4) the ability to deal with the insulin administration activity. In addition, rather than focusing on the diabetes function of coping with the treatment regime, the interaction activity mode is also part of the actions performed by players and the game's system. The interaction feedback loop consisted of (1) physical screen interaction (making the selection on the screen), (2) audio interaction, and (3) visual responsive feedback. The users' responses to the diabetes features were applied throughout the process. The responses regarding interaction feedback between players and the game's system through the iterative game design process were also investigated within the process and conducted in the next stage. Hence, the findings in this section provided the game features that must be maintained within the diabetes game system in the early stages of this research. This means that the prospect of players' feedback in the interactive system was explored after finishing the initial game, as will be explained in Chapter 6 (Design Research).

Additionally, developing the games' aesthetic was driven by findings from cluster three, identifying meaningful game playing motives (the notion of escapism). These findings enabled appropriate art direction to be conducted, which encompassed three subsections: (1) simplicity, (2) mood and tone that incites sensitivity of a fantasy world, and (3) the impact of the influence of Japanese manga on Thai childrens' media. According to the findings stated above, these concepts were used as the aesthetic design guidelines to offer the targeted audience attractive game visuals. The mood and tone of the demo version of the diabetes game in this study will be confirmed through insights found in the next chapter.

Finally, in terms of the play culture dimension, the culture of game playing is a significant factor in playing games that are immersive, as well as in navigating a game's design direction. This involves (1) parental anticipations of young children's game content, (2) effective narrative, and (3) establishing and supporting a Thai cultural embodiment that personalise game's characters' representation. First, parental expectations were informed through questionnaires as discussed above. This helps constrain the idea generation process of designing the content for children of the

targeted age. Based on this understanding, it was postulated that the effects of the game play perceptions of targeted players from these three social institutions are critical: family, school, and nation. These institutions play a vital role in the players' impression of the games, and therefore must shape the game's design criteria. The diagram below displays the three factors that influence the game design elements and the consequences of this within this study. Second, the role of Thai culture needs to be the epitome of the storyline, represented through the concept of prosocial behaviour, social relations, and self-hood and embodiment. The design storyline needs to be defined by the game content. Lastly, the game's character design needs to be steered by the third cluster, Thai cultural embodiment, which is understood through ethnographic methods. This helps identify the essential characteristics of the archetypes for Thai young children playing games. The game's main characters must enthuse child players because they are representative of themselves within the game's sphere. This conforms with the findings from Lieberman (2012), which mention that the relativity between players and games' avatars can enhance productive outcomes from serious games intervention. Hence, the games' character design guidelines must be demonstrated based on these above findings.
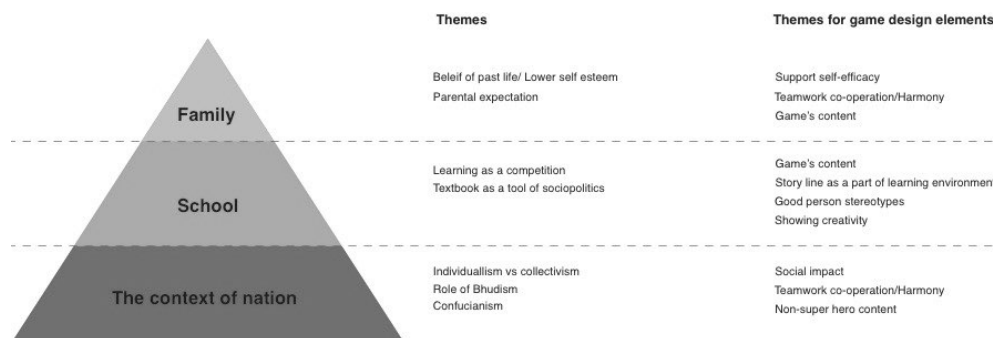
Figure 5.5 *The matrix diagram used to generate the ideas for diabetes game design guidelines II (Klangpremjit, V., 2019)*

Summarising the criteria of the game system points to the preliminary game design features. In this stage, an initial set of design guidelines to navigate the first game design prototype, based on insights from fieldwork analysis, alongside the literature's insights will be discussed. The details of each section of the design stage will be also considered in Chapter 6 (Design).

5.5 Summary of key findings

This chapter has provided insights into fieldwork results obtained from the model of diabetes games intervention. There were two strands of the research, demonstrated in Chapter 4 (Methodology): diabetes game's features and productive game play factors. Based on these two strands, findings were summarised into two categories. The first section identified diabetic children and their caregivers' requirements: (1) practising knowledge in real-life situations; (2) appropriate information for a specific age group (five to six years old); (3) monitoring and reporting insulin and diabetes data, and (4) rewards systems. These clusters were constructed from various responses in the first stage of data collection by clustering similar ideas that were repeatedly mentioned and significant statements. This analysis led to the determination of basic game features for the initial games in this study. The second strand was compiled using ethnographic research methods, which consisted of focus group interviews, observations, questionnaires, and drawing activities. These supplied three core drives of digital game playing motivation: (1) prosocial game play interactions; (2) inciting feelings of accomplishment; and (3) the notion of escapism. Each standpoint of these three clusters provided a better understanding of how these motives can be incorporated into a new game system model. The third section of this research will discuss the data on each element of the game system, which was obtained in Chapter 2 (Literature reviews). The model of implementing the fieldwork findings into the game elements to provide comprehensive game design guidelines for the next step of this research (Design Research).

Chapter 6: Design research

Exploring the components of productive play for diabetes games through design activities

In the previous chapter, fieldwork data regarding digital game-playing motives and type-1 diabetes experiences were synthesised, providing the core ingredients required to define productive diabetes game elements which will be used to help formulate the design guidelines. As such, this chapter will focus on how the refined data was applied in the initial game design process. Additionally, this chapter outlines each step of that initial process, from the identified game's features to feedback gained during the testing activities. This feedback was used to interpret and evaluate the final game prototype in the subsequent research stage (as described in Chapter 7: Design Evaluation, page 181).

Three main phases are discussed in this chapter: (1) the requirements analysis; (2) the design process; and (3) playtesting. The first section aims to determine the needs of diabetic children and their caregivers, helping to identify features of diabetic game systems, whereas the second section rationalises each design process undertaken during this research to support and detail the design decisions. The final section presents the playtesting feedback provided by the selected participants, as demonstrated by their responses to elements of the system. Based on the concept of gaming architecture mentioned previously in chapters 2 and 3, this section presents the participating children's playtesting feedback in subcategories according to the four game system elements (mechanics, interactive activity, playing culture and game aesthetic). Figure 6.1 illustrates how this chapter is structured, underpinned by the procedures from the IS research method outlined in the Methodology chapter (Chapter 4, p.67). The requirements analysis strand comprises three subsections, which are: (1) the framework of scenarios; (2) identifying stakeholders and their actions; and (3) documenting the scenarios. Following this, the design process and playtesting will be discussed in sections 2 and 3, respectively.
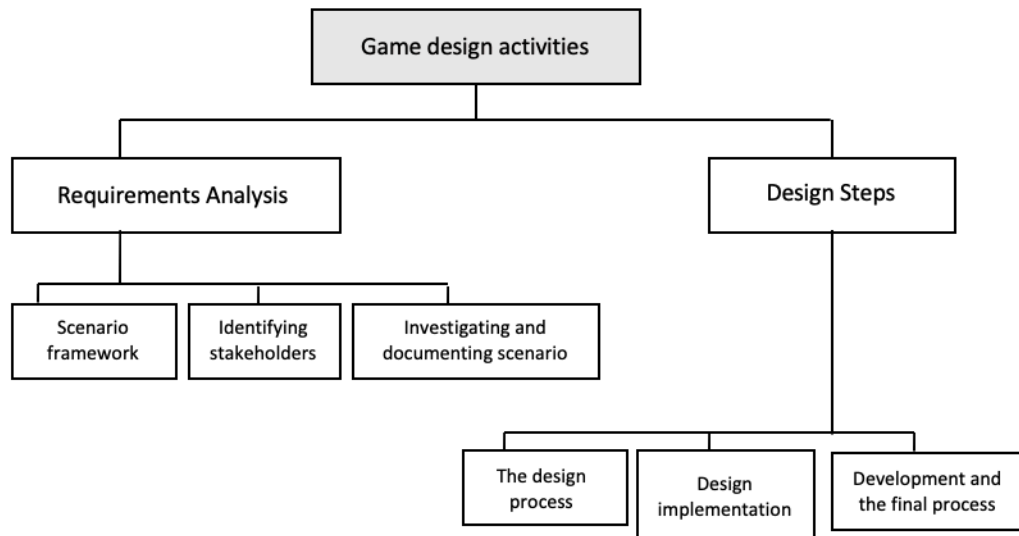
Figure 6.1 *An overview of the structure of this chapter (Klangpremjit, V., 2019)*

6.1 Requirements analysis

The first part of this chapter defines the stakeholders' interactive activities, which were subsequently incorporated into the game's system, as driven by users' data requirements. The requirements analysis is an essential step in which the designer identifies the concrete functions necessary to facilitate the end users' demands and requirements (Robertson, S. and Robertson, J., 1999). Once the users' requirements have been delineated, the framework of scenarios and the game's features will be stipulated as a set of design criteria.

6.1.1 Data interpretation and the framework of scenarios

Chapter 5 presented the analysed data regarding problems with coping strategies gained from the semi-structured interviews. Below, details of how the interview data was transformed into the criteria for defining the features of diabetic game design will be discussed. Eight key problems with type-1 diabetes experiences were frequently reported by the participants: (1) no school support; (2) lack of age-appropriate learning resources; (3) difficulty applying knowledge of coping strategies in reality; (4) lack of motivation; (5) lack of trust between home caregivers and school staff; (6) frustration with coping activities; (7) feeling separated from society; and (8) dealing with data difficulties.

According to the reported barriers of type-1 diabetes coping experiences, as mentioned above, the participating diabetic children and caregivers also suggested features that

they anticipated obtaining from the game system: (1) a mode enabling them to practice knowledge in real-life situations; (2) age-appropriate information; (3) daily reports of diabetic data; (4) monitoring of real-time data; (5) a mode of data organising; (6) a function connecting them to their personal doctor; (7) a rewards system; and (8) a means of enhancing empathy in non-diabetic children and school staff. Once this data was identified, the researcher encapsulated them into clusters with shared characteristics.

As aforementioned, the framework of scenarios would be shaped by the above data. This identifies the game features needed to support the player's needs. In this section, the details of how this data was transformed into the criteria for the features of diabetic game design will be discussed. The barriers to coping with diabetic conditions have been summarised into four clusters, which are: (1) obstructions to learning type-1 diabetes therapeutic information; (2) obstructions to dealing with the organisation of diabetes self-data in the daily routine; (3) obstructions to managing coping activities during the school day; and (4) obstructions to being engaged in repeatedly coping with experiences over an extended period. The first part, learning about therapeutic information, includes ensuring such information is comprehensible to the young child, applying knowledge of coping strategies to real-life situations and the simplification of therapeutic data. The second condenses ideas of reporting, monitoring, recording and manipulating of diabetic data, into a mode of dealing with daily data. In the third part, the daily management of diabetic data in school, encompasses the issues of co-operation between caregivers and schools, reporting real-time data and linking the games with the personal doctor. Lastly, in the fourth part that aims to promote players' motivation, the focus is on the notion of game mechanisms that play a role in persuasive triggers to urge and motivate diabetic children to tackle difficulties in their regimes.

The process of defining the game's features is illustrated in Image 6.2. In total, four steps were undertaken to determine these features at the design stage: (1) data interpretation; (2) identifying stakeholders and their activities; (3) investigating scenarios and; (4) defining the game's features.

Figure 6.2 The relations between the diabetic coping conditions of the stakeholders (Klangpremjit, V., 2019)

Details of data interpretation was provided in the previous chapter from the research gathered on the users. This guided the research by identifying the framework of scenarios in this stage. In the next stage, the stakeholders and their activities regarding tackling the diabetic games system will be identified.

6.1.2 Stakeholder identification and investigating scenarios

Diabetic child

- Doing insulin administration
- Learning coping with type-1 diabetes strategies
- Reporting daily data
- Balancing sugar levels

- The mode of informing sugar levels
- The source of coping strategies information
- The mode of data report to the caregiver

Caregiver

- Preparing insulin dose and food for schooldays.
- Taking note on what the child had eaten
- Monitoring child's data
- Learning coping strategies
- Searching information
- Consulting with doctor
- Managing equipment
- Doing insulin administration

- The mode of daily routines data organisation
- The mode of taking memo
- The source of coping strategies information
- Connecting mode to the doctor
- The mode of tracking child's daily data information

Teacher

- Helping the child to do insulin administration
- Reporting child's daily data
- Encouraging the child to constantly manage diabetes regime

- The mode of informing sugar levels
- The source of coping strategies information
- The mode of data report to the caregiver

Figure 6.3 Stakeholder activities and scenarios (Klangpremjit, V., 2019)

Once the framework of scenarios has been identified, those stakeholders identified by the framework scenarios are demonstrated. These are: the child, the caregiver and the teacher. The stakeholders for this initial game were targeted based on the aforementioned problems of coping with type-1 diabetes experiences. This was intended to resolve the cluster of managing diabetic conditions during school days and manipulating the diabetic data for both caregivers and diabetic child patients. In order to tackle this task, the semi-structured interview method was used to determine

stakeholder activity scenarios. The Figure below summarises these activities with regards to coping with a type-1 diabetes regime – the second column suggests features that might serve their requirements.

6.1.3 Defining game scenarios

The four abovementioned themes emerged from the task of documenting the scenarios, based on synthesising the interview data from both the caregivers (N=10) and the diabetic children (N=10). Once the fieldwork data was obtained from the semi-structured interviews, mind-mapping was used to categorise and synthesise this data for use in their daily lives. The mind-mapping technique is used as a tool to identify and link information (Robertson, S. and Robertson, J., 1999), whilst concept mapping helped to improve a hierarchical game's content structure, which framed scenarios at the design stage.

The concept mapping above allowed systemic and sequential identification of the diabetic activities mostly required by the participants to be applied within the game's system. Framing the coping activities also enabled categorisation of the stakeholders' tasks, based on their scenarios. The table (6.1) below indicates the categorised and encapsulated data which is summed up with the users' requirements in order to aid interpretation. The aim of this summary was to provide the concrete structure to create the game's features in the ensuing steps. Additionally, the data was condensed into a table to indicate the cluster of scenarios applicable to the diabetic game in this study. Four main scenarios were defined and categorised according to the type of interactive activity of the game system: (1) learning-based; (2) gaming-based; (3) self-data management; and (4) cooperation task scenarios.

Firstly, learning-based scenarios refer to the set of scenarios of this game intended to promote the learning abilities of diabetic children, in order to tackle the type-1 diabetic condition. This type of scenario also includes consideration of the practical application of therapeutic data and being interpretable to a young child. Within the game's system, the mode of learning coping strategies would deliver the diabetic child player with three sets of type-1 diabetic coping information, based on their developmental age and capabilities: (1) appropriate food and carb intake; (2) understanding balanced sugar levels; and (3) dealing with hypoglycaemia, hyperglycaemia[78] and unexpected circumstances

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[78] 'Hyperglycaemia' is a symptom of diabetes that refers to the state in which a diabetic patient's blood glucose level is too high. When the diabetic patient experiences high sugar levels symptoms, he or she must adjust the insulin levels in their blood to keep the glucose levels balanced. 'Hyperglycaemia' is different to 'hypoglycaemia' which is when a patient's sugar levels are too low (Hanas, 2012)

Secondly, the game-based scenario was designed to motivate the diabetic child to constantly manage their condition, as well as monitor, record and learn therapeutic data. In this mode of scenario, the intention was to interweave this into the other scenario clusters, by using its mechanics to trigger the child player using the game system.

Thirdly, the cluster of scenarios of self-data organisation was determined to manipulate a set of activities regarding insulin injections, balancing and the interpretation of glucose levels. Moreover, recording self-data refers to scenarios intended to manipulate diabetic data through the system, and also to report to caregivers (doctor, teacher and family). This includes interaction between the patient and the data, with regard to recording their states and the data interpretation for the caregivers. As such, the diabetic game features in this design research would consist of three main functions for coping daily with diabetes: 1.) learning-based scenarios, 2.) insulin administration and glucose monitoring and 3.) recording data. All of these functions would be optimised through game-based scenarios, as shown in Table 6.1 below, which also provides the data for the users' requirements.

Scenarios	Description	Activities	Stakeholders	Features involved
Learning-based scenarios	The mode allowing the child to learn about his or her diabetic information.	Learning about nutrition, sugar levels and how to cope with hypo- and hyperglycaemia.	The type-1 diabetic child at age five to six years and his or her teachers.	Learning about nutrition, sugar levels, and how to cope with hypo- and hyperglycaemia.
Game-based scenarios	The set of functions encouraging children to play in the game sphere.	Scenarios providing the sense of exploring the game world, budgets, scores and sense of belongings.	The type-1 diabetic child at age five to six years.	Providing a system of scores, badges and a leader board and giving a sense of exploration as well as promoting a sense of curiosity.
Self-data management scenarios	This set of scenarios includes activities regarding insulin administration and the monitoring of glucose levels.	Providing an alarm when it's time for insulin administration, showing the results of their score based on their glucose levels.	The type-1 diabetic child at age five to six years and his or her teachers and parents	Showing glucose levels, translating those levels into a token/score and representing that score.

Cooperation task scenarios	The mode allowing the child to learn about his or her diabetic information.	Allowing the child and his or her teachers to report their daily results.	The type-1 diabetic child at age five to six years, his or her teachers, family and doctors.	These tasks include taking memos and reporting on his or her condition.

Table 6.1 *The set of identified scenarios in this study (Klangpremjit, V., 2019)*

With the users' requirements clarified, the next section of this chapter will identify the design procedures undertaken in this research. The step from identifying stakeholders, to investing, documenting and framing scenarios facilitated the structuring of features for diabetic game design, in order to support coping with the daily diabetic regime of Thai children with type-1 diabetes.

6.2 The design process

This section provides the details of each design process undertaken in the initial stages of the game, as influenced by the researcher's career experience and enhanced by the underlying theories studied in the previous stage of the research. Those that informed the game's design could be divided into eight processes: (1) defining the game's genre; (2) creating the storyline; (3) designing the character; (4) identifying the game's rule; (5) designing the mood and tone of the games (the games' aesthetic); (6) defining the game's flow and sequence; (7) demonstrating the game's wireframe[79]; and (8) designing the interactive activities (between the player and the game system).

Before discussing the design process, it is imperative to outline the underlying theories which helped to form the blueprint for the initial game design. These were: the transtheoretical model of behaviour change (TTM) (discussed in Chapter 2, p.38), narrative structure principles and the health belief model (Chapter 2, p.38). Some of the design criteria discussed are considered to be arguments that emerged at the game design stage, which would be validated through the playtesting activity, and placed in the last section of this chapter. Not only would these findings be validated as design guidelines for diabetic games in the specific target group, but they would also be applicable in the development of the next game prototype in this practice-based design research (see Chapter 7-Design Evaluation), and would serve as evidence of this knowledge.

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[79] Wireframe is the term used to identify a visual representation of a screen-based interaction design schematic. The wireframe sketching technique is commonly used among interactive interface designers to manipulate on-screen graphic design elements, flow of use and the sequencing of the interactive content and information. The use of wireframe mainly focuses on interface design scenarios, features to be displayed on screen and information architecture.

Initial design guidelines

In advance of the design process discussion, this study determined three diabetes game-design guidelines for use in the design of the initial prototypes, which will be explored in the following section.

Design guideline 1: Adaptability with the stage of behaviour change

Those aspects of health psychology that seriously impact on games design considerations for healthcare promotion were discussed in Chapter 2 (Contextual review). These inspired the refinement of the framework of game scenarios into the different stages of behaviour change, in order to systematically and thoroughly manage healthcare behaviour. The concept of merging different stages of game play into the pattern of behaviour-change stages also supports the argument mentioned that each stage of game play offers the player different emotional experiences.

Therefore, this notion of different stages regarding the evaluation of healthcare perception – as shared by both the TTM and health belief model – will be reconsidered and the concepts applied to the initial game in this section. In Chapter 2 (Contextual reviews), the argument is raised regarding whether the overall concept of these two models fails to offer suitable insights into this particular study's context. For instance, the TTM posits that the patterns of a patient's behaviour are not placed nor run in a logical order, which the authors termed as 'flowing in a spiral fashion' (Prochaska, DiCiemete, and Norcross, 1992), while the health belief model draws on the assumption that purposed preventive behaviours (Conner and Norman, 2005). Because the targeted users for the game design research are young children, interpreting their improving health conditions is not too complex. In addition, type-1 diabetic children's experiences the with auto-immune diseases mean that coping with such debilitating conditions is not optional. The patient and caregivers must tackle managing these conditions for the children, from the simple to the multifaceted; those models that emphasise the notion of designing data into spiral and non-linear structures could be too complicated to be applied within their daily regimes, especially for the young child, as a stringent regime has to be constantly maintained.

The concept of apportioning behaviour change into five different stages was applied within this study. From this standpoint, it is possible to argue that to develop the diabetic child's pattern of behaviour change, the game's system needs to evaluate emotional experiences in a logical sequence. This helps to organise each player's knowledge from easy to complex steps, correlating with the young child's ability to learn abstract concepts. To summarise this argument, the initial game system was applied to the five stages of behaviour change that run in logical order: (1) from easy

procedures, such as appropriate food intake and suitable sugar levels, to difficult data, such as dealing with hypo- and hyperglycaemia, and the adjustment of insulin dosage; and (2) from the easy to difficult modes of data collection practice.

To apply to the initial game, five stages were determined with respect to changing patient behaviour within the game's system: (1) the beginning stage; (2) the contemplative stage; (3) the alteration stage; (4) the applied stage; and (5) the maintenance stage. To achieve the ultimate purpose of the game's design, the stages of behaviour change had to be applied to the game's mechanism, in order to motivate and nudge the patient to constantly manage their condition. Additionally, the game's content and mechanism, per se, had to be harmonised with the model of the patient's behaviour change. The beginning stage refers to that in which the diabetic player learns to cope with type-1 diabetes conditions and starts to immerse him or herself within the game's sphere. At this stage, players are provided with the basic information for dealing with type-1 diabetes and are encouraged to realise the negative effects that might result from ignorance of how to cope. The second stage focuses on the behaviour-change evaluation that drives the player with the game's triggers, based on productive motivational factors.

According to Chou (2014), the feeling state of game play can differ depending on the stage, meaning that the productive game-play triggers have to be differently served in each step of the game play. Hence, the concept of stages of behaviour change is interwoven with the game's mechanism, designed according to the motivation which might fit each stage of game play. For instance, almost all games for young children instil players with a sense of curiosity and exploration in the beginning stages of play. A well-known game that uses the mechanics of exploration is 'Minecraft' (2006), as well as 'Cookie run' (2012). Based on this notion, the design of the game mechanics in this design research leaned on the kinds of motivation that would be supportive of each stage of behaviour change in the diabetic child.

The Figure below shows the model of behaviour change that was incorporated into the game mechanism in the initial design, synthesised from fieldwork data and the contextual game review. The structured model identified five different stages of behaviour change in children with type-1 diabetes, divided accordingly into five stages of behaviour adaptation, running in logical order, as aforementioned.
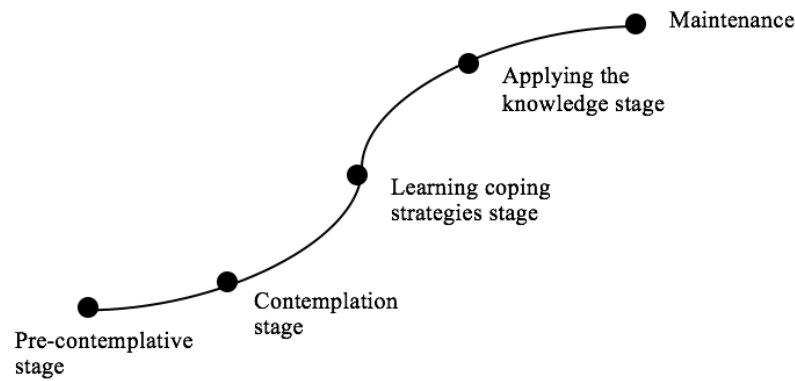
Figure 6.4 The stages of diabetic behaviour change applied from existing models of behaviour-change states
(Klangpremjit, V., 2019)

Figure 6.4 details the behaviour-change process that demonstrates the logical order of the healthcare perception for type-1 diabetes, mentioned previously (p.38, chapter 2). The first stage is when the game introduces the diabetic player to the overall concept and benefits of coping with the diabetes conditions, with the aim of moving them towards improved health. At this stage, the game also delivers a message with a core understanding and the principal coping strategies for type-1 diabetes, and instructional data with regards to managing any difficulties. In the second stage, the focus is on developing the player's perception of using the system to cooperate with the management of diabetes conditions in the daily regime. Those that encourage the child player to realise the negative circumstances that occur from coping ignorance, which can lead him or her to give up constantly, maintain their attention. In order to correlate with the game's motivational mechanisms, this stage aims to interweave the pattern of provoking healthcare awareness into playing emotions, that will be differentiated based on the stages of game play, comprised of; (1) immersing and introducing the player into the game's sphere; (2) playing the game's tasks; and (3) familiarising the player with the diabetic game's system. The third stage is where the diabetic child player becomes accustomed to the game world and the diabetic management system. This also highlights the concept that the child is committed to the process of diabetic behaviour change through the game's system. In this stage, the game offers the player triggers to evaluate knowledge of coping strategies. Learning how to tackle difficult conditions and being able to apply this knowledge to real-life situations, are the main functions of this stage. The fourth stage is action, with the emphasis on the idea that the player has already been immersed in and become hooked by the game's mechanisms. This assumes that the player has already begun to frequently adapt the pattern of coping behaviour into their daily routine. It is imperative to reiterate that the coping activities determined

in this study were: (1) reporting up-to-the-minute data; (2) balancing sugar levels; (3) learning therapeutic data; and (4) insulin adjustments and administration. Lastly, the maintenance stage is when the diabetic child has acquired an adequate ability to adapt and apply the coping knowledge and is also able to maintain their productive regime in future life.

Additionally, this study aimed to deliver the diabetic child player with the opportunities to validate healthcare knowledge in which they would be able to practice their comprehension of nursing strategies within the game's system. This also applies to new decisions on which the productive mechanisms might motivate a player to continually play the game in each stage of behaviour change, even if they might have reached the last stage of game play.

Once the logical sequences of behaviour evaluation have been illustrated in this section, the design process will be detailed. The initial game design was underpinned by these five sequential stages of behaviour change and incorporated into the structure of the game's mechanisms. At this design stage, insight into the child player's motivation, gained from the fieldwork was posited in each specific stage of behaviour change. To conclude, the game in this design research was developed to be adaptable to this model of behaviour change.

Design guideline 2: Harmonising concerns between entertainment and diabetes management

Balancing an amusing play experience within the diabetic game's system needed to be taken into conscious consideration in the design of the game. Diabetes games designed to evaluate a child's awareness and pattern of behaviour change, also needs to engage the player's interest alongside the process of game playing. In this study, the concern, that the diabetic game should be balanced between entertainment and learning to cope with a diabetic management regime, was taken into account. When a game offers the child player addictive mechanisms, such as a strong narrative, continuous quests and time-consuming mini-challenges, the player's attention is presumably on the content rather than on coping with the condition.

In order to keep a balance between these two concepts, the game would need to be designed to limit the user's playing time to several short periods during a single day, based on their coping activities. In addition, the game needs to be capable of being paused and played numerous times. Taking into consideration existing games that use the play-and-pause technique exemplified is the best way to achieve this. For instance,

'Hey Day'[80] (IOS and Android, 2012), uses a non-continuous playable strategy by limiting players' abilities – that is, the player is not able to constantly grow crops and must wait three hours before planting again. This also encourages the player to look forward to resuming game playing and to see the process of evaluation within the game's world during this time. In case the player does not want to wait three hours, he or she has to pay for the game with actual money, which will unlock their capabilities in gaming performance. This strategy can be seen currently in well-known games, such as Realm of Valance, (2016), Cookie Run (2012) and the diabetes game, Monster Manner (2016).

This project summarises the design techniques that would be applied to harmonise these two components in the initial game into three principles: (1) limitation of game-playing frequency within a day, based on the coping regime; (2) evasion of persuasive storytelling and game triggers; and (3) using the pause and resume technique. Such defined strategies as these impact the way in which a game designer considers a game's content, genre and the state of flow within the design process.

Firstly, limitation of play frequency refers to the technique of constraining the player from repetitive playing. Most well-known games apply this technique to serve marketing intentions in the form of the player needing to exchange actual money in place of the game's virtual currency (e.g. points, badges, unlocking items and tokens). This premeditated strategy differs from the research purpose herein, which is aimed at balancing healthcare awareness with entertainment. Secondly, this study argues that spotlighting the game's narrative as a main component of the game itself might lead to addiction among young players. To affirm this point, taking into consideration popular games that contain strong overtones of narrative structure, reveals common techniques. Most of these games provide the player with the technique of character role-playing – e.g. Persona 4 (2012), Last of Us (2012), and Watch Dog (2014). Lastly, the technique of pause-and-play at anytime, denotes a design system that allows the player to resume playing without any feelings of discontinuity from suddenly quitting. The exploration of this concept has enabled the game-design guidelines to be refined to encourage short-term playing over playing the game for longer periods. As a consequence, the research approach was refined and the framework of design guidelines identified. This also helped to define the game's genre, content, motivational game triggers, the personality and embodiment of character design, the game's flow, and lastly, the player's emotional state at different stages of the game. Each of these elements of the design process will be discussed in section 2 (The design process).

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[80] "Hey Day" is a farm-based simulation game that allows the player to simulate running a farm, designed by British games developer, King company (2012).

Design guideline 3: Ease of use for children aged five-six years

This section will discuss the target group's capabilities to operate the interactive game system. Chapter 2 reviewed the concept of designing for young children, with regard to on-screen interaction. There are three subsections outlined within this section: (1) physical development; (2) cognitive development; and (3) emotional development.

The first subsection, physical development, focuses on the way in which a child player interacts with the screen and devices' monitor. This covers the design aspects of both visual perception and making on-screen selections. For ease of use, in terms of visual perception, this study highlighted the capabilities of the target group to use an on-screen interface. In the first instance, games for young children must deliver simple forms of on-screen selection and three concepts lay within this design consideration: (1) drag-and-drop selection; (2) simple click and release; and (3) targeting specific areas on screen. Moreover, this study explored age-related issues in the area of on-screen interaction through playtesting feedback of the initial design, as detailed in the last section of this chapter. This initial playtesting shed light on understanding the appropriate type of interactive activities that it was anticipated would serve the specific users in this research, and the initial game prototype explored the child's touchscreen performance in order enhance knowledge in designing the children's interface. This thesis argues that early-age user is impatient; as such he or she will expect to see immediate feedback from their actions.

To conclude, the design guidelines subsection concerns the child's abilities to perform interactive tasks on-screen, and to deliver the player with a simple means of making the on-screen selection, for instance, with a single-, double- or hold-and-release-click interface. The second strand on cognitive development explores the child's perception of on-screen visual representation through the game system. The design research constructed a set of design guidelines that were used in the first stage of the game design. To serve young children, an overload in typing function needed to be avoided as well as complexity of text representation and meaningful icons (Druin, A, 2004; pp. 398-405). Offering the child a text-based instructional mode is not appealing visually to the game world. Additionally, in the early ages of development, the child is able to decipher metaphorical content better than instructional data, especially for educational purposes. This correlates with the idea that metaphorical guidelines can help the child player to remember the methods of completing tasks within the game's system.

Lastly, the strand of emotional development considers the way in which the game encourages the child player to interact with the system. From this standpoint, this subsection of design guidelines underscores the encapsulated idea from the Literature

Review in chapter 2, which identified the persuasive element needed in diabetic games. According to children's developmental levels, games must immerse the player in representations of on-screen (virtual) characters (Hana, et al., 1999; Lieberman, 2001). This also includes the technique of storytelling which is believed to aid children's perception of the game play experience. In addition, the notion of a rewards system has been frequently cited by serious game scholars, as maintaining the player's interest through challenging moments in the game's lifespan. This research explores engaging factors, evaluated by taking into account the player's emotional state at each stage of the change in the behaviour and the perception of the diabetic child. Fieldwork data revealed a connection between the concept of player's emotional stage and guideline 1, demonstrating different motives in the child player at each stage of game play. Delivering different emotional triggers was also amplified by the insights gained from the fieldwork, which revealed the different types of persuasive motives for the child at different ages.

The following section of this chapter reveals the emotional development data taken into consideration in the construction of the game's flow, mechanisms and the type of rewards system in the initial game design. In closing, this design process was steered towards diabetic game design, based on these three guidelines, with each helping to define the game's design elements

Initial game-design steps

The design process, undertaken in the initial game design prototype, was underpinned by a process frequently adopted in the game-design industry, knowledge gained from personal game- and UI-design experiences. Rather than relying on practical experience, this research was conducted using the principles of the conventional game-design process, which determined the 'guideline process model' for the designer, as frequently referred to in games design studies (Bates, B., 2004; McShaffry, M., 2009; Salen, K., and Zimmerman, E., 2005). Image 6.5 below portrays the design process that led to a systematic evaluation of the games model mock-up used in this design research.

Image 6.5 also shows the seven stages in the design implementation that were applied in this study: (1) designing the content and storytelling; (2) defining the game's mechanics (i.e. rules, emotional playing-state, and triggers); (3) designing the game's aesthetics; (4) defining the interactive activities; (5) designing the characters; (6) designing the game's interface; and (7) identifying the game's flow.
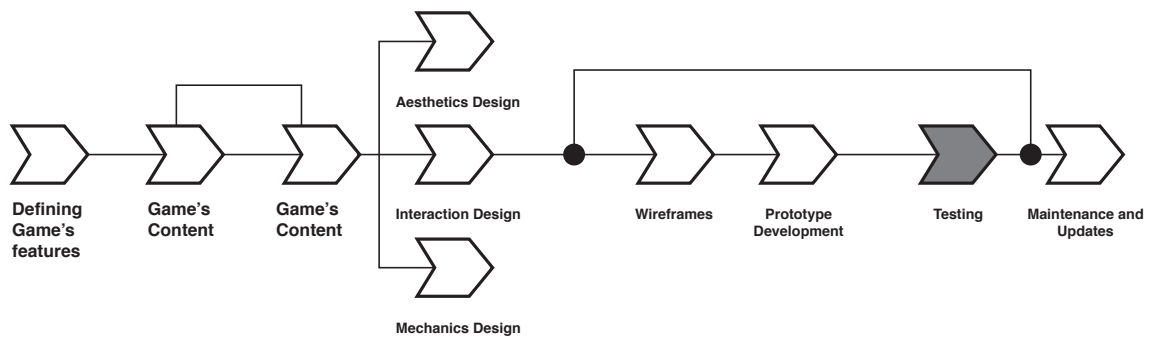
Figure 6.5 *The games-design structure applied in this research (Klangpremjit, V., 2019)*

Designing the game's storyline and content

Using the analysed data and design guidelines mentioned above, the game's initial storyline and content were identified. There were five criteria needed for the content and genre selection of this initial prototype, in order that the storyline be appropriate for five-six year-old diabetic children:

1) The content needed to be familiar to young players;
2) The content needed to encourage the child to be creative;
3) There could not be any violent content in the story, based on parental expectations;
4) The story needed to be appropriate to the diabetic treatment regime, meaning that a non-linear story should be suitable;
5) The story needed to appeal to both genders.

Once the selection criteria for the storyline had been determined, the game's content was refined by reviewing the existing media within the child's environment, as it presumably met the parents' expectations of child-appropriateness. In addition, it was assumed that children of the target age would be acquainted with this content. From the observation data, it is evident that the children wanted to imitate people in real life. Most of the toys they played with were imitating real-life objects, which would not be appropriate for their use in reality, such as kitchenware, weapons, gardening tools, models of residential buildings (from houses to castles) and tools related to occupations (doctor, teacher etc.). This emphasised the findings in the literature that children prefer to use their imaginations, allowing them to escape from reality.

In this study, where the diabetic game was purposed for both genders, it was imperative to include a balance of attractive triggers that would appeal to both boys and girls. Fieldwork data revealed that boys were interested in playing with imaginary items and imitated powerful characters, such as superheroes, while girls preferred not to obsess over this type of content, but were more engaged in showing their creativity by playing

at being a real-life person, such as a chef, a gardener, a teacher or a mother. It might be assumed then, that the idea of simulating a super-hero is more effective at grabbing boys' attention, while girls are attracted more to showing their creative abilities. From this point of view, it was necessary to choose a storyline which would fulfil both of these types of motivation. As such, five possible game genres were selected: simulation, RPG[81], adventure, MMORPG[82] and sport games (see Table 6.2).

Design Criteria	Simulation	RPG	MMORPG	Adventure	Sport
The children must be familiar with the content/ be able to relate to the story	X		X		
The content must support their creativity and imagination	X	X		X	X
There must be no violent content in the story	X				X
The story theme must be appropriate to the treatment regime, meaning that the non-linear story might be most suitable	X	X	X		
The content must be of interest to both genders	X				

Table 6.2 The game genres which met the criteria for the initial design stage (Klangpremjit, V., 2019)

Before devising a storyline for the game prototype, it was decided that the most appropriate genre for the targeted user would be simulation because this type of game could provide the player equally with feelings of accomplishment and creative fulfilment. There were four reasons to support this simulation type as being the best fit for this study: (1) ease of incorporating therapeutic information; (2) ease of balancing entertainment with diabetic coping strategies (design guideline 2, p.144): (3) ease of

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[81] The term 'RPG' stands for Role Playing Games referring to the genre of games that allows players to situate his or herself into the game's world through narrative structure. Inside RPG games, players are able to impersonate their chosen role inside the game's world. In this research, some well-known RPG games are used to investigate the structure that aims to engage the player, for instance, Grand Theft Auto (GTA), Realm of Valour (ROV), and Pokémon Go!

[82] The term 'MMORPG' stands for Massive Multi Online Role Playing Games referring to the genre of games that allows players to situate his or herself into the online game's world through narrative structure.

providing the player with a sense of creative expression and immersion in an imaginary sphere (4) ease of play for children of the target age group.

Once the genre had been determined, the existing simulation games for children of this age (five to six years old) were surveyed. This review enabled a comprehension of the elements used, the narrative and the graphic-design interface which could be successfully deciphered by this age of players. The three measures of suitability stated above were taken into consideration when making decisions at the design stage. The scope of this exploration was narrowed down by surveying only popular simulation games in Thailand, patented between 2014 and 2018 as these were expected to reflect the common interests of the target users. The subjects of these games were farming, cooking, virtual pets, and territorial battle. An intriguing finding was that some games which hadn't been initially targeted at young children turned out to be much-loved by this age group; for instance, 'Cookie Run'[83], 'ROV'[84] and 'Pokémon Go!' Chapter 3: State of the art contains a detailed analysis of some of these games. The insights gained from this analysis were revised at this stage to consider the elements of game design used, in order to apply them successfully to the initial design prototype.

Table 6.3 below shows five storylines and types of content that were used to engage children in the target group, as defined during the research period, which were deemed potentially suitable for this study's aim in helping diabetic children to cope with their conditions. The five storylines designed for the main part of the game were; (1) virtual pets; (2) farming and gardening; (3) cooking; (4) battles of good and evil; and, lastly, (5) space. According to the criteria checklist, the gardening simulation game was selected as the initial content appropriate for providing the necessary in-depth insight during playtesting feedback.

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[83] Cookie Run is a famous mobile application game created in 2010 by the Japanese company, Line Mobile, as a part of a chat application. The game represents cookie characters who race each other and the players are scored on the basis of how much distance they cover at each stage of the game.

[84] Realm of Valour (ROV) is a 'Multi Online Battle Arena'-style game , that is, a multi-player online battle arena or real-time strategy game created by Garena, a Singapore-based games company (Garena RoV Thailand, 2016).

Design Criteria for game's content	Space	Pets	Cooking	Gardening /Farming	Sport
The children must be familiar with the content/ be able to relate to the story	X	X	X	X	X
The content must support their creativity and imagination		X		X	
There must be no violent content in the story	X	X	X	X	X
The story theme must be appropriate to the treatment regime, meaning that the non-linear story might be most suitable	X	X		X	
The content must be of interest to both genders	X			X	

Table 6.3 *Game content popular in Thailand during the research period (2014-2018) (Klangpremjit, V., 2019)*

Initial game synopsis

The initial diabetes game in this study was designed to use gardening simulation to engage children to cope with their diabetic regime. The game was intended to stimulate the child players by allowing them to take care of the garden and to promote diabetes learning through this simulation. Within the garden game, players could earn tokens and rewards, encouraging the player to explore the new plant, new recipes and to expand their garden. Based on the cooking activity, the player could learn appropriate food intake from the recipes they cook using ingredients cultivated in the garden. Additionally, the player could gain tokens and rewards from their frequency of caretaking activities regarding the diabetic regime. At this stage of the design, the games' activities were differentiated according to the diabetes coping features mentioned in the first section of this chapter, in Table 6.1, p.139.

Learning-based scenarios	The learning-based scenarios would be incorporated into the garden game mechanisms, as follows: (1) the balancing of sugar levels to earn tokens to expand the gardening area; (2) the learning of appropriate food intake from cooking activities; (3) the revision of coping strategies through the 'My library' feature; and (4) the practice of counting cards and food choices through the mini-quiz challenge.
Game-based scenarios	To balance the coping activities with the game's mechanisms, the garden game would promote play through the gardening simulation feature. This would comprise cooking, plant-growing and crop modes, horizontal expansion of the garden space, and a mini-quiz challenge mode which would allow them to choose appropriate recipes for the type-1 diabetes condition.
Self-data management scenarios	To manage the patient self-data, the garden game would deliver this function through the 'My diary' mode. This gardening care concept would be used as a metaphor for the manipulation of self-data. Within this function, three sub-features would be embedded in this mode: recoding what the child has eaten, reporting their garden's status and encouraging constant care through the exploration and expansion of the garden world.
Cooperation-task scenarios	The game would aid the diabetic child and caregivers through the mode of daily reporting in which the process of caring for the garden would be a metaphor for monitoring diabetic data, unlocking features within the game – for instance, the daily result would be reported to caregivers in the form of gardening report data.

Figure 6.6 The game's content categorised according to the game's features (Klangpremjit, V., 2019)

Defining the aesthetic

Once, the game's content had been determined, the visual aesthetic needed to be decided. This was done by exploring the existing games and relevant media for the targeted group. Based on the synthesised fieldwork data in the previous chapter, it is evident that the game's visual appeal would be embedded within the concept of escapism represented through three key ideas: (1) simplicity; (2) a fantasy mood; and (3) a Japanese style of aesthetic (N=76)(Abe, K., 2005). To sum up, abstract representations of people tend to simplify the human figure and serious subject matter into a concept of intense childlike innocence that will be applied in this design. This notion, sometimes perceived as 'cuteness', was influenced by the wide dissemination of Japanese children's media in Thailand during the research period (2014-2018). To conclude, this project identified the game's mood design guidelines along three measures, demonstrated as follows:

1) Simplicity: ease of which the shape could be recognised by the target group
2) Sensitivity of the fantasy aesthetic: through using colourful tone and magical elements
3) Sense of cuteness: providing the feeling of attachment, childlike innocence and the fetishised relationship between the player and the game's styling (i.e. character design, virtual NPC and the game's sphere)

Next, the game's mood boards were created to help define the tone of the graphic elements for this initial game. The collected images on these boards were gathered based on content relevant to the garden game type and aimed at a similar target audience to this project. Hence, the garden game was designed to immerse child players into an imaginary world, which would encourage them to eagerly explore the virtual game's sphere, based on content identified as being of interest in the fieldwork. According to the three clusters that defined the core concept of the gardening game for this project, the theme of the visual representations was defined. Firstly, for simplicity, the garden game was designed using shape elements simplified from the form of the object in reality. This concept is commonly used in children's media to aid in deciphering visual elements (Mullican, M., 2008; Kress, 1996). Secondly, to provide the target users with a fantasy visual representation, the garden game would offer the player a vivid colour scheme and distorted, surrealistic elements. Lastly, the design aesthetic of cuteness would be applied. The game would be designed through the imitation of Japanese animation style in the media, representing visual aesthetic in the form of round shapes, bright colours, child-like innocence and inciting the feeling of attachment, as per the visual psychological development of the child, between the player and the game's avatar.

The images shown below exemplify the visual styling of similar children's games relevant to the design criteria in this study, upon which the graphic styling of this initial game was based.

Figure 6.7-6.8 *The mood board images generated(Klangpremjit, V., 2019)*

Designing the game's characters

This stage involved representing the player as a virtual character in the game sphere. As with the previous stages, this started with exploring relevant character designs in young children's media. According to the simulation concept, the game's visual representation would be achieved through a two-dimensional perspective, in which the space of the player's garden would be expanded in the horizontal direction. Additionally, the player would not see their character's body, but only see through their eyes from a first-person perspective; they would, therefore, see their garden from a vertical viewpoint, while almost all of the well-known simulation games deliver the play experience from a tilted angle – an isometric bird's-eye view. This study argues that playing the garden game from this perspective made it easier for the target users to decipher, presenting them with simple graphical elements in accordance with the design guidelines.

Character design was not of primary concern in this simulation game, as the player would focus mostly on the gardening process, rather than on the representative character. In spite of this, the characters were designed around the notion that their creation would generate a relationship between the player and the game system; hence, the garden game would allow the player to customise their virtual avatar through an option to design their character.
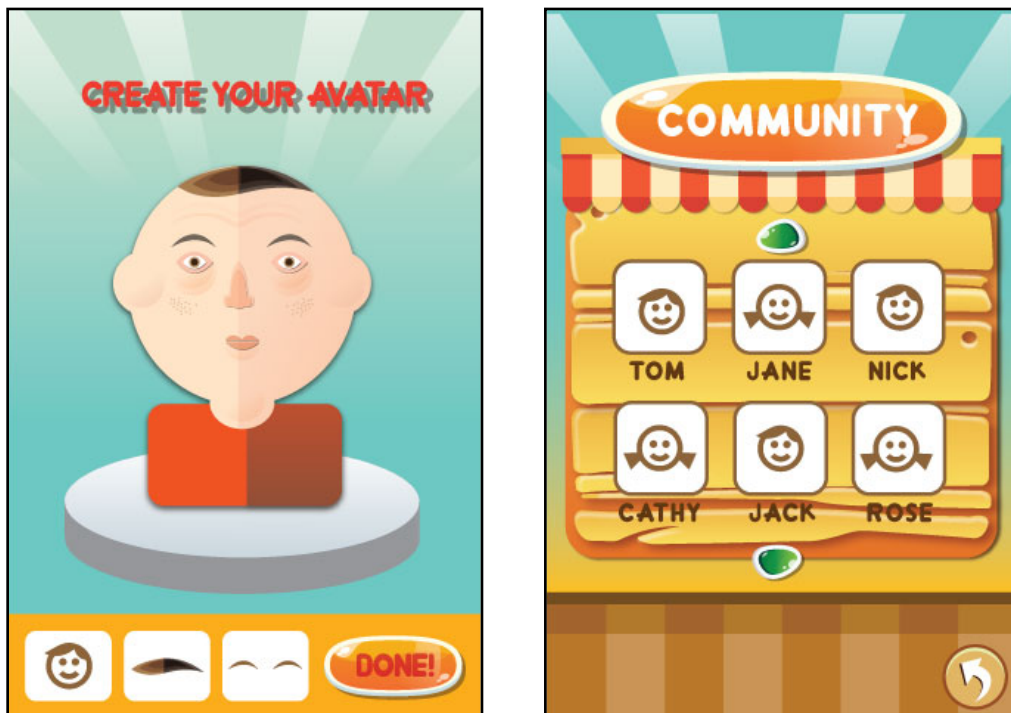
Figure 6.9-6.10 *The game's avatar creation options were provided at the beginning stages of game play, to enable the user to design their own avatar. (Klangpremjit, V., 2019)*

Four criteria were used to inform the design of the game's characters in this project.

• The representation of morality in the characters' personalities;
• A sense of cuteness: exuding a childlike innocence, evoking the feeling of attachment and a fetishised relationship between the player and the characters;
• A harmonious tone to the game's design;
• The avoidance of elements that might give out violent signals (e.g. characters that are armed, hostile or racist).

The numbers of the characters were illustrated to ascertain the best fit for the gardening storyline in this game. As previously stated, the tone was distorted from real life as well. The preliminary sketches were drawn to reflect how geometric, rounded shapes would be used to harness the human figure. For this, the most appropriate and appealing characters were selected, based on the aforementioned design guidelines and criteria.
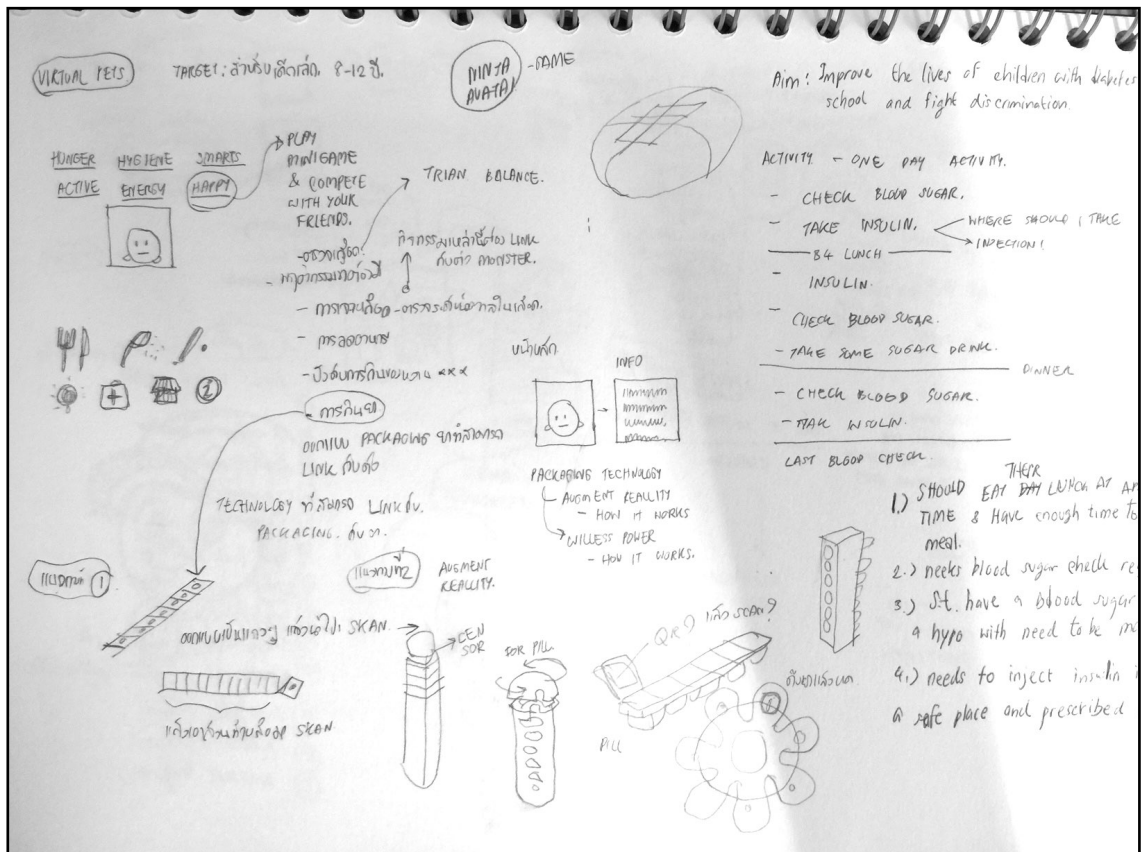
Figure 6.11 Stakeholders' activities and scenarios sketch design (Klangpremjit, V., 2019)

From the sketch designs, it is obvious that the characters were simplified using geometric, round shapes in order to be harmonised with the mood and tone of the game, as stated in subsection 2 (defining the aesthetic, p.152). The initial game depicted the

characters that reflected simplicity and cuteness. The figures below show the number of character design sketches intended to represent the child player in the gardening world.

Figure 6.12 *An evaluation of the character designs within the garden game (Klangpremjit, V., 2019)*
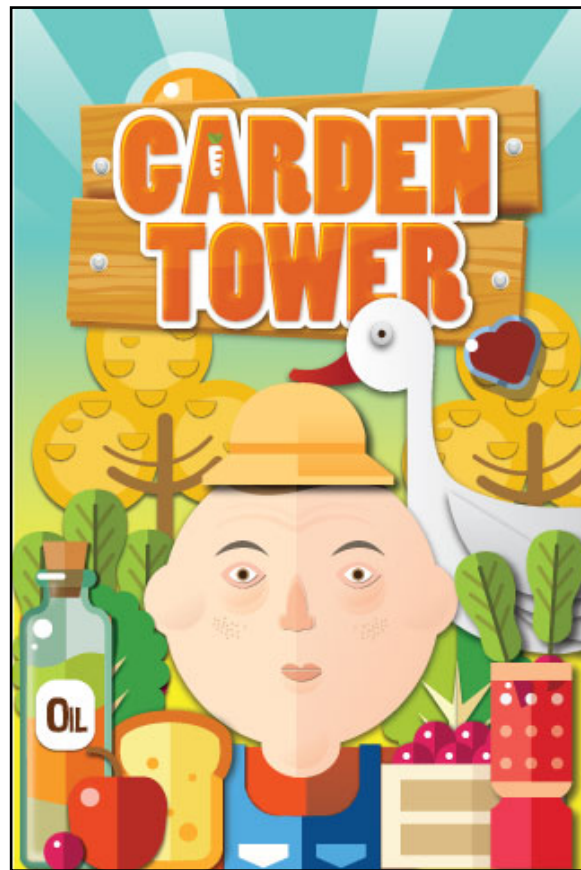
Figure 6.13 The final version of the character designs (Klangpremjit, V., 2019)

Designing the rules (as a function of the game's mechanics)

According to the fieldwork data, which provided an understanding of what type of rules, triggers and game mechanics could be used to encourage children of the target age to play the game. However, not only these insights were considered in the creation of the game's mechanisms but also how these motivations would be harmoniously intertwined with the coping strategy features. This meant that the rules of the game had to be coordinated with the diabetic treatment regime, in order to support and motivate the paediatric patient to cope with their condition in daily life. As stated in design guideline 1 (p.141), the entertainment experience and coping conditions had to be consciously controlled.

To design the rules, the synthesised clusters of digital game-playing motivations for the target player were revised. The triggers were also defined based on these themes. Knowledge outlined in chapter 4 (Data analysis) informed the three clusters that had been determined as motivational in young children in Thailand, which were: (1) inciting a sense of accomplishment; (2) providing the player with a sense of escapism; and (3) encouraging prosocial behaviours. As such, the garden game's system mechanisms would be designed according to these guidelines. The game rules in this project referred

to a set of game-playing agreements that would be made between the players and the game's system, dictating the manner in which the player could operate in the game's world. In this version, the terms of the game rules were placed into two categories: those rules identifying the playing abilities of the user, and those referring to the methods of archiving the game rewards (the rewards system).

First, the rules involved in the game mechanics would navigate the play performance. In this garden game, based on the design guidelines, the basic rule identified was that players must constantly maintain their ability to cope with diabetes and maintain attention whilst playing to win the game's tasks and achieve rewards. Additionally, playing time would be limited based on the archiving tasks and the game's flow. The player would also be prevented from repetitive playing by limiting the daily play time, based on the player's coping activities in daily life; failure to report data would be taken as indicative of ignorance of coping with diabetes, meaning that the player would miss the opportunity to gain rewards that would validate them to expand or unlock and increase their gardening abilities in the game. This feature related to the idea of considering the rewards system as an independent strand of the game's rules. With respect to this garden game, the tokens and rewards would not only rely on the ability to maintain the coping regime, but would also include: (1) results of sugar levels; (2) results of the mini-quiz challenges in the learning of coping with diabetes data; (3) results from making appropriate food choices in the mini-game challenges; and (4) the caregivers' feedback regarding the diabetes daily results. To clarify, any type of rewards gained from the system would authorise the player to; (1) unlock ingredients to be able to cook appropriate recipes for the type-1 diabetes condition; (2) expand the horizontal gardening space; (3) enable the purchasing of more virtual materials (e.g. seeds, costumes, gardening decorations and equipment). Figure 6.16 below exhibits the game's economics that would be maintained in the garden-game system, as characterised by the actions based on each of the game's features.

Playing actions	Scores
157	
Checking sugar levels Reporting sugar levels Sugar levels between 80-100 mg/dl Sugar levels less than 80-100 mg/dl Sugar levels more than 80-100 mg/dl Being able to adjust the insulin dosage	- 20 tokens - 50 tokens - 50 tokens - 10 tokens - 10 tokens - 100 tokens - 100 tokens
Mini-quiz challenge with regards to appropriate food choices Mini-quiz challenge with regards to appropriate levels of sugar Dealing with hypo- and hyperglycaemia Ability to tackle unexpected situations	- 20-60 tokens - 20-60 tokens - 20-60 tokens - 20-60 tokens
Reporting daily data Reporting sugar levels Recording self-data Keeping memos Gaining positive feedback from caregivers	- 30 tokens - 10 tokens - 10 tokens - 10 tokens - 20-50 tokens
Harvesting Cropping Cooking per single recipe Uploading gardening outcomes Selling crops or recipes	- 20 tokens - 20 tokens - 20 tokens - 20 tokens - 20 tokens

Table 6.4 The game's economics and reward currency, differentiated according to activities for coping with type-1 diabetes and game-playing actions (Klangpremjit, V., 2019)

Figure 6.14 The game's shop in which the player is permitted to buy ingredients   (Klangpremjit, V., 2019)

Table 6.4 shows the rewards that could be gained from different playing actions, as defined by the four features. This reveals the values of the actions, based on the difficulties of coping with diabetes activities. The images below illustrate the rewards system that was applied to the garden game according to game's economics.
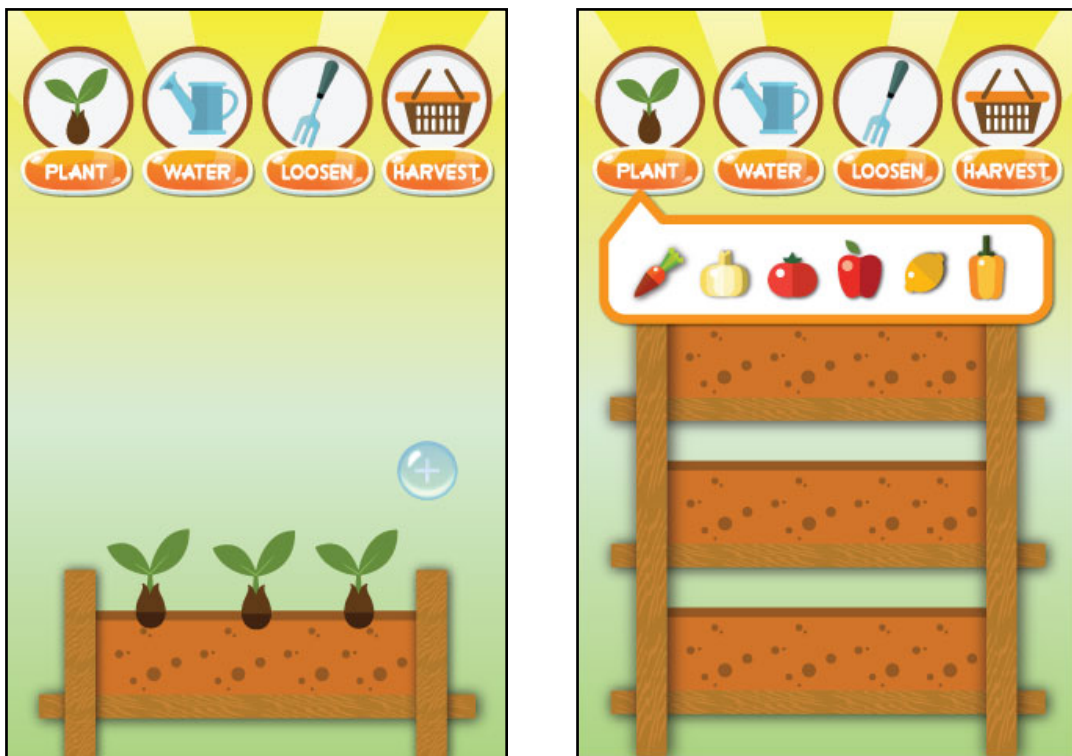
Figure 6.15 Expanding the horizontal gardening space (Klangpremjit, V., 2019)

Figure 6.16 Unlocking the ingredients (Klangpremjit, V., 2019)

Designing the game flow

In this prototype, the game's flow refers to the way in which the player would be able receive the set of emotional triggers and gaming mechanisms, running in logical order of the gameplay experience, whilst coping with the type-1 diabetes regime. The garden game introduced the child player to storytelling, designed to immerse the user in the game's world through the technique of an illustrated book. Figure 6.19 (p.167) below visualises the game's wire frame, which indicates the gaming sequence in this version. The garden game urges the player to constantly manage and be concerned about their diabetes condition through the spiral (non-logical) ordering. This meant that the child user could play any function of the gardening game at any time; for instance, he or she could simply switch between the gardening and cooking modes. Based on this spiral ordering of the game's flow, the player would be sent those internal triggers designed around the features of coping with type-1 diabetes (learning coping strategies, administering insulin and managing self-data).

Due to the spiral ordering sequence, however, each of the sub-features needed to play out logically to make it easier for young children to operate the game's system. For instance, in the learning diabetes mode, the flow of the features was designed to run from step to step. The child would be required to know where to go next, upon entering

159

the feature. The flow of each gaming feature during this stage is shown in the Figure 6.17 below.
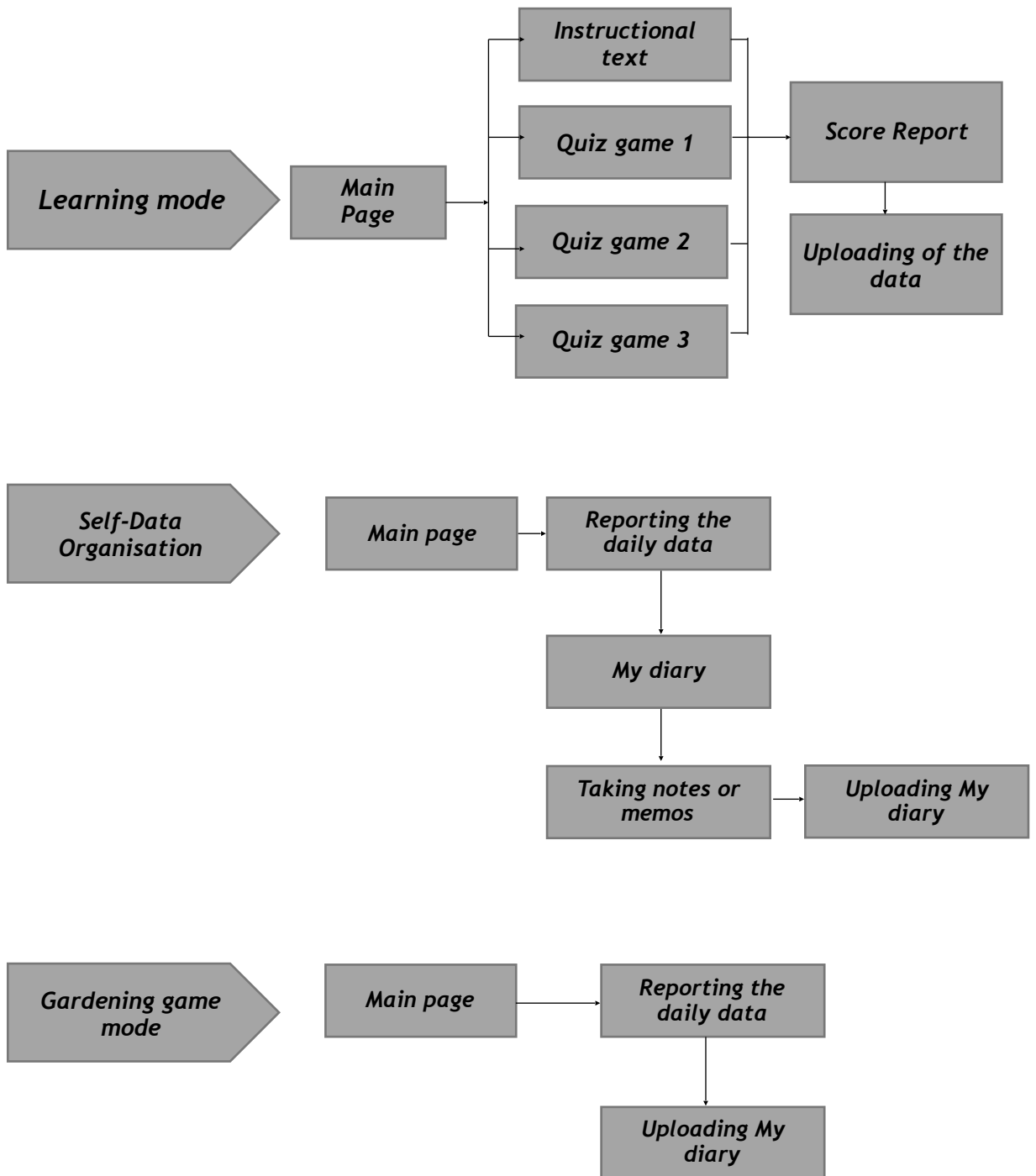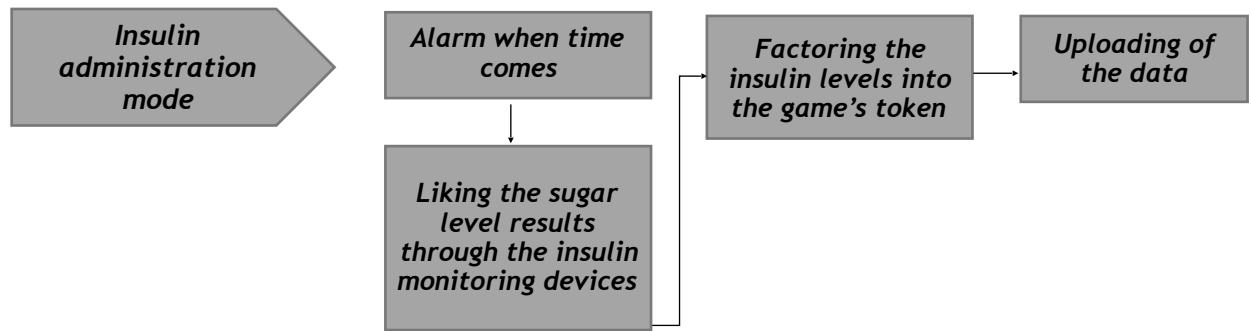
Figure 6.17 *The overall structure and initial wireframe of the gardening game application (Klangpremjit, V., 2019)*

Not only was the ordering of the external drives considered, but this research also focused on the sequence of the state of the player's emotions, with a view to identifying the internal triggers that would promote the player's engagement throughout the game's lifespan. This focused on how the internal mechanisms could stimulate the player to be constantly engaged with the game and remain excited at each stage of play. This approach argued in the earlier section, that the state of the player's emotions and his or her motivations would differ according to the diverse stages of game playing. This section focuses on the concept in which internal triggers need to run in logical order for the player in each stage of game playing. According to design guideline 1, the garden game was based on the concept of the five stages of type-1 diabetes behaviour change. The overall aim was to combine the model of behaviour change with the gardening game mechanism and the features of coping with diabetes management.

To clarify: firstly, the garden game would deliver the storytelling and tutorial mode to the player at the beginning stage of game playing, in order to provide the player with information on the game functions. Additionally, this stage would exclude complex information on coping with type-1 diabetes and would instead focus on introducing the game's concept. In coping with type-1 diabetes management, the introduction stage comprised the recording and interpreting of sugar levels and the reporting and recording of self-data, which would translate into game tokens if the task were to be accomplished. The internal triggers were embedded within this introductory stage and delivered in the simple form of challenges designed to maintain the player's sense of exploration, feeling of accomplishment and immersion in the gardening world.

Secondly, when the player adequately acquired a skill for coping with diabetes in the form of tokens or gardening outcomes, the player would be allowed to access the second stage where the task difficulty level would slightly increase. Moreover, the

garden game would help the player to engage with the game's system through unlocking the stages, gardening decoration, customisation and caring for the garden. This would encourage the child player to feel a sense of ownership, curiosity and exploration. Also, to promote children's prosocial behaviour, the garden game would instil the player with a sense of being part of society through a community mode, allowing the Thai diabetic player to communicate, interact with other players or virtual character and make suggestions on the experience of coping with type-1 diabetes and the game-playing progress (gardening progress). In order to share and exhibit the gardening progression, the game would provide a feature for exchange, trade and selling of crops and recipes or even missing ingredients, turn these into tokens within the game's world.

In the third stage, the player would have the ability to adjust and recreate recipes based on their creativity and knowledge of appropriate food choices for their diabetes condition. Amounts of virtual currency and substance would relate to the gardening progress outcomes, which would in turn, be dependent upon the user's ability to cope with diabetes behaviours. In addition, this stage delivered boosted complexity of coping strategy data, such as dealing with unbalanced sugar levels, tackling unfamiliar situations and preparing insulin dosages. This stage would also highlight the concept of helping the child player stay engaged in the garden game's mechanisms. The fourth stage, termed 'the adaptation stage', would promote the player to continually play the game in order to extend their knowledge of coping strategies and formulate their usual habits of diabetes management. The sense of ownership and accomplishment achieved by expressing creativity from their gardening outcomes would be highlighted in this stage, driven by the mechanics of unlocking further features, such as selling virtual decorations and exploring new recipes. Lastly, the fifth stage is where the player would be able to apply the information from the gardening game in reality. Which means that the stage tends to maintain the game's engagement that aimed to transform the game playing routines to the diabetes coping habits.

The next part of this chapter will explore the type of interactions that were created in the initial game.

Figure 6.18 The gardening game scenarios and wireframe (Klangpremjit, V., 2019)

Designing interactive activities within the game

The term 'interactive activity' in this study refers to the player's actions whilst interacting with the game's system. Almost all of the determined interaction types, such as making on-screen selections and the audio design, were based on design guideline 3, which emphasised the interactive capabilities of young children. There were two strands of consideration for designing the interaction in this initial prototype. First, was the on-screen interaction. The gardening game would be operated on a touchscreen device; therefore, effective interaction for the targeted users would be necessary as they must be able to operate the screen through the action of touching. At this stage, the different types of interaction that could be contained within the game's system were explored. Table 6.5 sums up these possible ways of making selections on a touchscreen, which were subsequently selected to be used in the garden game.

The game's features	Type of interaction	Function
Learning mode	-click and release -hold and release	-making the selection -reading data -playing the mini quiz
Insulin administration	-scroll and release -typing	-fulfilling the data -reporting the data -making the selection
Self-data organisation	-drag and drop selection -hold and release -click and release	-fulfilling the data -reporting the data -making the selection
Gaming mode	-click and release -typing -hold and release	-planting the crops -harvesting -buying -cooking -making the selection

Table 6.5 Types of on-screen selection that were used in the initial project (Klangpremjit, V., 2019)

The table above demonstrates the types of on-screen action that were categorised based on each of the game's features.

In the second strand, the audio interactive design, it was intended that the audio would amplify the playing experience for the targeted users in the game's world. To intensify

the experience, the garden game would have added instrumental music alongside the game playing. In addition, the audio in the game would inform the player as a type of feedback to their touchscreen action, such as successfully clicked, drag and drop and typing. This was aimed to formulate meaningful interaction and feedback for the child players.

In conclusion, the game's design process has supported the design decisions that have been made in this initial stage of and the prototype game. To study the play responses of the participating children, a game model mock-up needed to be created and tested. The following section will detail the playtesting activity that aimed to achieve playing responses in the study's target users.

6.3) Playtesting

Test design activity

To study the interactive capabilities of young children with the game system, it was essential to observe and explore how participants played the game. A prototype mobile application of the garden game was created and tested with 20 non-diabetic children (N=20) at age five to six years. The game (Garden Tower) was tested on the participants without providing instructions on how to play the game, allowing them to explore by themselves. The data to be gathered during this playtesting activity was determined as follows:

1) Is the game's storyline engaging the target users?
2) Is the game's appearance attractive to them?
3) Can the relationship between the game's characters and players be enhanced?
4) Are the rules engaging for the players?
5) Is the game's flow easily interpreted by the players?
6) Is the game's interface easy to operate and decipher?

Based on these questions, participants were recorded whilst playing the game. This took one hour per group (N=5) of participants in the room provided in their school or home. The participants provided feedback whilst playing the game through verbal and non-verbal expressions, which were securely recorded on a laptop. In the test design study, 20 normal children were recruited and divided into four focus groups.

To analyse the feedback gained from test design activities, as with the previous stage, data was grouped into categories based on each element of the game design system and research questions. The design procedure undertaken in this step was similar to that

used in the data-analysis fieldwork, with subsections, including manual transcription, immersion and organisation of the data via 'N-vivo'. Using N-Vivo, a data management software program for researchers, it was possible to observe and consider both the participants' non-verbal expressions (such as facial expressions and body language and signals), and verbal expressions in order to enrich interpretation of the data in this project. Both verbal and non-verbal data was organised, separated and analysed, based on those ideas relevant to each of the game's elements.

Test design feedback

The feedback from the test design activities will be explained according to each stage of the game design process, which are: (1) storyline, (2) character design, (3) the game's mechanics, (4) the rewards system, (5) the game's aesthetic and (6) the game's flow. Firstly, however, it must be noted that this test-design fieldwork data was analysed in order to generate themes for the players' insights and to create a more developed version of the final design criteria. The content analysis was depicted to synthesise this information, determined by the frequency of the significant statement and the meaning behinds the participant's proclamation. To access the themes for these findings, the data was revised several times and analysed, in order to determine the crucial findings and to formulate the evaluation of the final design disciplines, based on the design elements.

Figure 6.6 below shows how the information was manipulated through the principles of the content analysis methods (Krippendorff, K., 2004; Weber, R., 1990). The significant statements in the form of verbal and non-verbal expressions were highlighted and grouped into clusters. Next, each cluster was revised to produce a final version of the themes related to the findings. These themes were then used to generate the design criteria in the next step – design evaluation.

Significant Statement	Meaning	Cluster	Theme
I don't know where to go next after I grow the crops.	Struggling with the game's flow	Problems with the game's flow sequence	*Defining the game's flow*
The children pointed to the ingredients icon on the screen and asked, 'What is this?'	Ambiguity of symbols and icons in the game	Problems with the game's visual/ graphic design	*Defining the game's aesthetic*
'The game is too short and I am looking for more things to do within the game'	The game was not challenging enough	Problems with the game's motivational triggers	*Defining the game's mechanics*
The child had to click many times on the same icon	Some of the game's features were not responsive to them	Problems of game's production techniques	*Defining the game's production*
'I think the game is a little girly and very camp'	The game was not attractive to boys	Problems with the game's appearance	*Defining the game's aesthetic*

Table 6.6 Data analysis of the test-design feedback (Klangpremjit, V., 2019)

The table above shows the themes that were synthesised from the applied fieldwork data. Those that were clustered based on the game's design process are discussed below.

Feedback on the storyline content

The target users reported that game's story was not attractive to them, especially the boys. The storyline of cultivating a garden was determined as too close to the reality of their daily lives. From observations, the children preferred to play with content that allowed them to explore unfamiliar worlds and become immersed in imaginary experiences. In addition, the gardening game content, which allowed the player to gain tokens to extend and customise their garden, was criticised as being too easy – again, especially for the boys (N=8).

The observation data showed that participants tried to find more tasks to play, rather than simply growing crops and creating recipes within the garden game. This was identified through their action of repetitively clicking on icons and symbols which were not designed to be functionable; for instance, one student clicked on the image of the bench in the game's screen. As a consequence, it was determined that nearly half of the participants were not engaged with the garden content, and one factor supporting this was the fact that the game's triggers were designed to be too basic and were easily archived. Additionally, in the Garden Tower game, the gardening content did not deliver the child players with persuasive internal or external triggers within the game's system.

Feedback on the game's mechanics

The design mechanics in the Garden Tower game spanned three categories: (1) emotional triggers; (2) the rewards system; and (3) the sequence of the game's flow. Based on these categories, it was possible to organise the data.

Feedback on the emotional (internal) triggers embedded within the game's system:

From the testing activity, some wisdom was gained regarding the sequencing of the emotional design triggers that would need to be embedded within the game's mechanics in order to instantly engage the player throughout the playing experience. Relying on the five-stages model of patient behaviour change underpinning this study, the state of the player's emotions would be critiqued through the notion of sequential game mechanics applied for patient behaviour change, as previously mentioned.

First, the participants argued about factors that they anticipated seeing in each stage of the game system to continue to play. The feeling of exploration was satisfied by the child participants, as it was placed in the beginning stage of game play, encouraging them to explore the gardening world. Some of the participants suggested that the opportunity to express their creativity should be posited in the beginning stage as well, claiming that there were insufficient options provided in the avatar-creation mode to fulfil them at this stage of game play. Additionally, it was determined that the game design should provide a myriad of avatar types with different design options; for instance, a variety of ethnicities or human versus fantasy characters. The participants' feedback also revealed that, in order to be engaging, a sense of achievement should be possible at every stage of game play. From the observation data, it was noted that each child participant had waited to receive rewards, as a response to their actions and archived tasks, even in the beginning of game play. Moreover, the participants stated that they wanted to discover something on each day of game playing. This emphasised

the necessity for an element of surprise to be embedded within each stage in addition to creativity, achievement and imaginary supports.

Whilst the participating children (N=20) did not mention the prospect of demonstrating their creativity in the garden game system, this issue was evident from their playing actions during the playtesting activity. The participants showed that presentation of their creative outcomes should be laid down in the stage in which they had mastered the game playing; for instance, by showing the recipes, the decorated garden or the avatar creations. From this perspective, expression of the players' creative abilities was constrained due to the limited options contained in this gardening game. This was further highlighted by some of the child participants who mentioned that they did not feel they could create or customise the garden as they had expected. This demonstrated the fact that the virtual sense of belonging was not optimised in the game design, as originally intended; if the player is not provided with a comprehensive variety of options in the game's system, the feeling of belonging will not be invoked in the player. Due to this feedback regarding the internal triggers, it was possible to reconsider these issues (the sequence of the game's internal triggers).

Feedback on the rewards system

The rewards system articulated in the garden game consisted of four types: tokens, unlocking mechanisms, badges, and leaderboards, which the player could achieve based on their ability to manage their type-1 diabetes. The coping activities of the type-1 regime demonstrated in the game system were: (1) data-learning activities, (2) insulin administration; and (3) self-data organisation.

The participants gave critical feedback of this rewards system as the garden game was not well-balanced in terms of the game's economics. The children believed that tokens earned from balancing sugar levels and the insulin intake activities were too few compared to the price of buying options in the game's shop. This meant that in order to be able to create their recipes and decorate their garden, the player had to wait too long to accomplish each task, which might lead them to quit playing. Furthermore, opportunities to gain tokens and rewards were linked only to coping with diabetic activity so it was suggested by the child participants that the game would be more engaging if it provided more diverse opportunities for rewards (N=14). Feedback was received with regard to the unlocking mechanisms, badges and leaderboards, which were regarded as well-balanced in the garden game (N=20).

Feedback on the game's flow

As previously mentioned in the figure illustrating the player's state of emotions in design guideline 3 (p.146), the garden game did not introduce the player to storytelling. The player was instead delivered direct to the main menu page providing three main features: (1) Your garden (allowing the player to create, customise, grow and harvest crops in the garden); (2) Your library (the mode in which the player could view their diabetic self-data, look at treasures and recipes to make, or learn about coping conditions); and (3) Your kitchen (the mode allowing them to create meals from recipes appropriate to their diabetic diet).

The game's storytelling mode was the stage in which the players were introduced and began to be immersed in the game's storyline. As feedback on this feature, the participants suggested that the narration should take place at the early stage of game play (N=12) as some of them did not fully understand the overall concept of the gardening content.

From the standpoint of the game's features, the main menu page was set as the first page. On this screen, there were three main functions: garden mode, library mode and kitchen mode. The participants became confused and struggled with this page as they did not know what functions they were supposed to play first (N=17). Placing the main menu function at the beginning of game play did not offer an appropriate ordering for the child at this particular age. Four of the participants had clicked on library mode and found that there were no tasks for them to be operated at that early stage. Consequently, they thought that the games did not offer any tasks and concluded that it was too hard to interpret. Furthermore, the garden mode feature was reported as problematic because most of the participants did not know which icons were designed for buying crops and which were for decorative garden ornaments. The way in which the game portrayed those crops already purchased did not provide responsive feedback to players. In addition, another function that they recommended be fixed was the progress of crop growing and harvesting, which was too slow for them to observe.

In summary, there were three main problems found during the initial design tests regarding the game's flow and its sequential mechanics: (1) the story was not narrated in a manner appropriate to this particular age of player; (2) the main page in the beginning stage of game play should have presented those features that needed to be operated first and; (3) the game design systems needed to be more responsive. Based on the feedback gained, the insights which emerged allowed a new set of design criteria to be devised in the next stage of this study.

Feedback on the game's visual design

The garden game design offered players a sense of childlike cuteness through simplified characteristics and a vivid colour scheme delivered through the tone of brightness. Cuteness in the game was achieved by a reduction in its representation of reality, friendly-looking shapes and disproportionate scaling of forms created a feeling of surrealism. As mentioned in Chapter 4 (Data analysis), the influence of Japanese media has long played a big role in shaping Thai children's interests and its style is known as 'Kawaii' (chapter 5, p.125). The initial game design in this study was built upon references to the various media which constitute a crucial part of the intriguing content and appealing visuals to which the Thai child is subjected, such as comic books, online digital platforms, media and television programmes. Throughout the garden sphere, an ironic form of nature and the human figure was portrayed through simple geometric shapes to represent this sense of cuteness. The feedback on this graphic style was that it was more appealing to girls, rather than being unisex. All the boy participants reported that the game's appearance was too childish and appeared fairly easy and unchallenging. Moreover, using the geometric graphic styling reminded them of educational media so that it did not give the impression of being a serious digital game. Conversely, the female participants mostly seemed pleased by this graphic appearance. Relying on the feedback of the game's aesthetic, the participants' criticisms were arranged into three categories: (1) a childish and colour associated with appealing to girls; (2) the use of overly simple geometric shapes; and (3) suggestions of mood and tone in this garden game.

Firstly, using vivid colour tone did not seem to be attractive to the five and six-year-olds. Based on the playtesting interviews, the participants were engaged in and influenced by their surrounding environment, trying to mimic adult behaviour (N=20). Almost all of them were playing adult game content, such as ROV, DOTA online and Cookie Run. This also potentially made them proud of themselves, as they believed they could conquer seemingly difficult games. Consequently, the childish design of the garden game was not appealing to the boys (N=8). As a result, the next game prototype would need to strike a balance between graphic attractiveness to children of both genders. Secondly, the aesthetic of the game's world with its geometric forms was reported in the interviews as too childish to the players. In addition, the mood and tone of realism might have given the child a sense that this was a mature game and thereby seem more attractive in terms of appearing challenging. Some of the children responded in a more mature way. However balancing the graphics to appeal to both genders should be considered in the next stage of this project.

As a consequence, the participants were asked specifically which graphic elements they thought seemed childish, and they responded that it was the simple designs, basic

geometric shapes, and the use of a vivid colour scheme and tone. In spite of this, the childish design may appeal to early age children, but this design aesthetic was not inspiring to children at ages five and six, as this is the age in which they start to imitate adult behaviour (Smith, 2012).

To conclude, the terms of the aesthetic were defined according to the insights gained from the participants' feedback, which were: (1) graphics appealing to both genders; (2) a defined fantastical style and imaginary world, avoiding the tone of educational media.

Feedback on the game's interactive activities

In this context of the game design, interactive activity in this study refers to the way in which children operate and interact with the game's system. In order to gain and analyse feedback on the game's interactive system, it was imperative to separate the interactive elements into sub categories, three of which were identified in this study: physical, visual and audio interaction. The interactive-activity feedback data demanded categorisation and led to the generation of certain criteria. The physical interaction mode included interaction with the screen, on-screen selection and operation of the game's tasks. The visual interaction mode focused on the way in which the child player interpreted, deciphered and synthesised the visual language of the game while the audio interaction mode denoted the child player's perception of the audio within the game.

During physical interaction, the drag-and-drop selection mainly included techniques of making selections in the garden game. This was achieved on the screen and did not seem to be familiar to children of this age. It was observed that the children playing struggled with some modes of drag-and-drop selection, such as the shopping mode, which allowed the player to drag a crop icon into a basket for purchase or the growing of crops, in which the player had to drag seeds into soil in order to plant them. Hence, the drag-and-drop selection technique in this initial game was not considered sufficiently responsive, as icons were reported as problems when the player attempted to drag them into a destination point on the screen. This was also supported by the interview data gathered by the expert game designer, who found that the drag-and-drop technique may be appropriate with a large monitor or screen, but for some devices it might inconvenience the player (N=15). From the fieldwork observation, it appeared that participants were familiar with making simple selections. Furthermore, the problem of making on-screen selections in this garden prototype was that there were no signs to represent their selection progress. The players also suggested that sound could be used to show a response to their selection.

Table 6.7 below illustrates the summarised data focusing on the feedback from the physical interaction – i.e. the players' responses – gained from the semi-structured interviews and observation. This demonstrates that problems occurred with the participants playing the initial game in terms of physical interaction.

Game's features	Type of interaction	Function	Problems founded
Learning mode	-click and release -hold and release	-making the selection -reading data -playing the mini quiz	-none
Insulin administration	-scroll and release -typing	-fulfilling the data -reporting the data -making the selection	-too slow and not responsive enough -no response signals to identify an accomplished operation between the player and the system.
Self-data organisation	-drag and drop selection -hold and release -click and release	-fulfilling the data -reporting the data -making the selection	-no response signals to identify an accomplished operation between the player and the system.
Gaming mode	-click and release -typing -hold and release	-planting the crops -harvesting -buying -cooking -making the selection	-too slow and not responsive enough -no response signals to identify an accomplished operation between the player and the system. -the hold and release technique was reported as non-responsive

Table 6.7 *Summary of data showing feedback on making selections on the game's screen (Klangpremjit, V., 2019)*

From the data in the table, it is evident that drag-and-drop selection led to problems for players, particularly in the area within the garden game system. Additionally, 'responsive reflection' refers to when the system provides a response to the player that echoes their actions; for instance, when the player drags seeds into soil, some visual effects were supposed to pop up, in order to identify that the seed had been planted. In the design prototype for the Garden Tower game, there were two types of feedback

system: visual effects and audio effects. With every click for making a selection on the game's screen, a sound effect was intended to respond to their action, in order to support the visual effects, indicating when each action performed had been registered in the system. To show these kinds of effects, the game offered two forms of response: (1) pop-up windows, including messages such as 'Congratulations', 'Time's up' and 'Fail'; and (2) visual representations in the form of graphic language to show the response to the player's action, such as twinkle graphic elements appearing around the item, twinkle-effect pop-ups when new recipes had been cooked and when crops were ready to be harvested. In addition, visual pop-up effects were suggested in the design for when the player clicks on an object informing them that it has been selected. In the mode of purchasing garden ornaments, for instance, the object selected might momentarily become enlarged with light shining around it, in order to make it obvious to the player.

Three types of errors were reported in feedback from players, with respect to this design effect, which occurred while they were playing the game and were unresponsive, non-responses showing, based on production problems, which were; low budgets of household production, coding experiencing and limited time scale of production.

In the audio interaction mode, it is important to state that the garden game was based on three different design objectives; (1) To respond to the player's on-screen selection; (2) To enhance the immersive experience of the player in the game's world; and (3) To promote an exciting experience for the player when being transferred to another stage of game playing. In the first objective of using sound to respond to the player's interaction with the game on screen, no problems were reported in this model prototype, while the background music within the game's world was criticised as being a disturbance to the gaming experience. A few of the participants noted that playing the same song throughout the game playing made them bored and annoyed. In addition, using different background music at different stages of game play was reported as not supporting their gaming experience, due to feeling the music did not complement the situation within the game stage.

To sum up, relying on three aspects of interactive design activities, the data from this stage fulfilled the game design elements enabling the definition of a new set of design criteria. Firstly, making the selection on screen needed to be amended and had to be defined by new techniques. Secondly, the majority of obstacles that happened at this stage were based on production problems. Lastly, the background music embedded within the garden games was too repetitive. The feedback gained in this part was reviewed in the next stage of the final game design.

Producing a fully functioning feature that aimed to test diabetic behaviour change led to high costs and also took a long period of time to finalise and test. To solve these problems, the research had to separate the model testing activity into two stages. Testing with this model prototype was aimed to understand persuasive factors of playing digital games for Thai children aged five to six years old, considered as a pilot study in this full-scale research. This initial stage focused on understanding the feasibility of using these set of games design guidelines and game's triggers that driven by the fieldwork data in the previous stage. These insights regarded meaningful and persuasive factors gained in this stage were harnessed into the final model prototype that tended to interpret how these persuasive factors can promote behaviour change and coping with type-1 diabetes experience.

6.4 Conclusions

In this chapter, the findings from fieldwork data was integrated into the game design procedure with the aim of creating a set of guidelines for designing a persuasive gaming experience for children aged five to six years, based on the understanding of the Thai cultural context. The design steps relied on two stages for defining users' requirements and the game design procedures. The first strand defined those features synthesised by the understandings of the user requirements and were mainly gathered via the interview method. This determined the features of the initial game for this project, which were: (1) self-data organisation; (2) the learning mode; (3) gaming features; and (4) a feature for optimising insulin administration activity. Secondly, the game-design process phase demonstrated the stages of design consideration and decision, which were undertaken in this project. The knowledge gained from previous chapters was used as a tool to determine and frame the design criteria in each step of the game designs, including the storyline, rules, characters, mood and tone, flow and graphic interface.

At this stage, the design guidelines were perfected and synthesised into three main concepts: (1) adaptability with the behaviour change model, (2) harmony between entertainment and therapeutic considerations; (3) ease of use for children of the target age. These guidelines thus helped the process of making decisions regarding each of the design elements – for instance, selecting the game's content, sequencing the game's flow, ordering the internal and external triggers and even designing the characters and gaming interface.

The last section of this chapter has focussed on the playtesting activity of the initial prototype's experience, without testing the diabetic dimension, in order to perfect the game design, which aimed to gather the targeted players' feedback regarding the

functioning of the game's elements. In this study, a qualitative content analysis was applied, as with the previous stage for the fieldwork data (Chapter 5-Data analysis). The findings from the playtesting feedback were clustered based on the game-design process, undertaken in the relevant section. The feedback gained in this stage was subsequently synthesised into the next stage of the game's development and will be discussed in Chapter 7- Design Evaluation (p.178).

Chapter 7: Design evaluation

Development of the diabetic game intervention in this study

This chapter discusses how the responses and reactions from playtesting activity will be used to evaluate the design of the final diabetes game design. The final design guidelines were formulated by translating the players' feedback, based on each aspect of the design elements, into the evaluation of gaming design criteria. Throughout this final design section, the design process will be discussed in a linear way, emphasising the idea of apply the feedback into the design guidelines, in order to evaluate the final design prototype. The chapter also discusses the feedback from the player-identified problems that occurred while playtesting.

The table below encapsulates the findings from the playtesting, categorised by main themes from players' significant statements: (1) response to the coping-with-diabetes features, (2) storyline attraction, (3) adapting the game mechanics, (4) aesthetics, and (5) modifying interactivity. These main themes of player feedback lie in three subsections embedded in Table 7.1: themes, players' requirements, and new design criteria.

Summarising design criteria based on players' feedback		
Themes	*Players' requirements*	*New design criteria*
Coping-with-diabetes features	1.) Too much text for a child of this age. 2.) The technique of merging diabetic-coping data to game mechanics was not appealing to the player. 3.) Some of the information on coping was not relevant to child's cognitive development.	1.) Defining new types of coping information based on the capabilities and cognitive development of children aged 5–6 years. 2.) Harnessing a set of information on the mini-game challenge such as nutrition information for the quiz game. 3.) Using pictures instead of blocks of text.
Storyline attraction	1.) The story was not attractive to players as it represented content that was too close to their daily life and to typical educational media. 2.) The garden story content was too 'girly' for boys.	1.) Finding a middle point of content in the interests of both genders for children aged 5–6 years. 2.) Offering a sense of exploring a new world, allowing players to escape reality content.

Summarising design criteria based on players' feedback		
Adapting game mechanics	1.) The technique of story narrative in the garden game was not appropriate for children of this age. 2.) The main page of the game's menu provided options for the game's features and the child players struggled in terms of sequential playing. 3.) Some of the game's function was not responsive to players' actions.	1.) Finding a new narrative technique as it was supposed to have no text and be brief yet attractive. 2.) Redesigning the game's menu relying on game's sequential function. 3.) Fixing the problem spot within the game's system.
Game aesthetics	1.) The garden game was criticised for looking too childish and not challenging enough for the boy players. 2.) The graphics were similar to educational media and so the child players did not find the content relaxing.	1.) Balancing graphic appearance to be more mature, yet still have a child-like look. 2.) Offer a hint of rebellion for the child players.
Modifying interaction activity	1.) The problems were due to the complexity of the on-screen drag-and-drop selection. 2.) The sequence design in the game was not well organised.	1.) Generating simple techniques for making on-screen selections. 2.) Repositioning game features based on understanding players' emotional triggers.

Table 7.1. Summarising design criteria based on players' feedback (Klangpremjit, V., 2019)

Synthesising the data from the playtesting responses helped to redefine the design guidelines for a new game model prototype in the next step of the game design. The players' feedback data has been summarised to form design guidelines that will be discussed in the next section.

7.1) Identifying Design Guidelines

Design guideline 1: Stimulating imaginative storytelling and emphasising the idea of escapism

From the previous stage, stimulating a sense of curiosity and a feeling of exploration were frequently mentioned throughout the interviews. This is supported by some data from participants revealing that they anticipated seeing unexpected and surprising content embedded alongside the game experience. This feeling engaged them as it promised imaginative circumstances that they didn't have the opportunity to experience in their daily lives. Offering players an attractive world provides them with a sense of curiosity within the game's sphere. However, as mentioned in the last section (p.171) on an engaging storyline, was not the only consideration for the game designer – another

was to meet parental expectations. Thus, to evaluate the final design's criteria, it was critical to re-consider the game's content in terms of, both attracting child players, and pleasing their parents and caregivers. Based on data from the parents' interviews, parents seemed to be satisfied that the content was consist with educational content, which contradicted the child players' desire for something different and unexpected. To find a balance in this aspect it was essential for the design to list the children's media content that might be relevant to both sets of expectations. Additionally, the game's storyline had to be easy to integrate within the model of behavioural change, demonstrated in the earlier criteria marked as stage five of the diabetic patient's behavioural change. For this reason, a new approach to defining the game storyline had to be narrated through a non-linear storyline, rather than a linear narrative structure so as to match the pattern of behavioural change, defined throughout this study and mentioned in chapter 6, section 2 (p.140).

From this standpoint, applicability to educational content was posited as the basis for considering an appropriate storyline, as well as finding potential content for developing it into a fantasy world for the diabetic child. As a result, the data was summarised according to these criteria:

1.) Relevant to educational media content;
2.) Non-violent;
3.) Providing the feeling of exploration and drawing players into an imaginary world;
4.) Appealing to both genders;
5.) A sense of challenge;
6.) Adaptable to the five stages of behavioural change.

To conclude, the storyline of the final game prototype had to be concerned with an imaginary and fantasy world that was also relevant to the content of educational media, as stated above. The game's storyline had to give the player a sense of adventurous exploration.

Design guideline 2: Deliberately focus on the game's sequence
In the gardening-game prototype, the flow was ordered based on this game designer's career experience and the usual structure of conventional game design. The game had the main menu page, in which several features at the start of gameplaying were shown. Through the player's feedback of this initial game, more than half of the participating children's responses revealed that, offering all features on the main menu bar on the first page made them difficult to interpret. Hence, in summary, the main menu page was supposed to identify the current status and updated outcomes of the player – for

instance, showing the gardening space as the main page of the game system, and embedding the menu bar in the corner of the screen. Image 7.1 models of the game sequence, applied to the new game below.
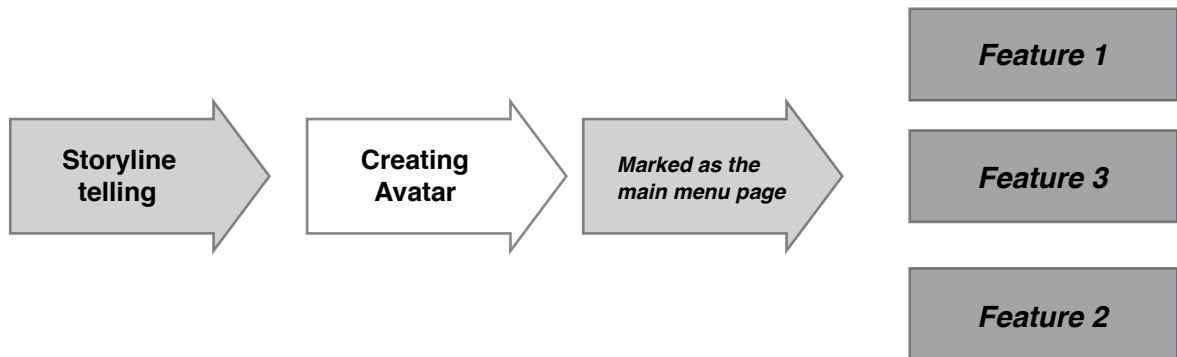
Figure 7.1 Game flow for the final design prototype (Klangpremjit, V., 2019)

To design an effective game flow, the storytelling of the game should be posited at the first stage of the gameplay. Due to of the problems of game flow stated above, the new game sequence relied on this model. Before leading the player into the game tasks, the storyline was narrated for new players to immerse themselves in the game's sphere, and then the player's avatar appeared on the second page of the game system. The game's world map, determined in the diagram above, refers to the page that exhibits whole outcomes for players, representing players' progression in the game. Three main features lie within this world map page in the game's system. They are: (1) learning to cope with diabetes mode, (2) insulin-administration mode, and (3) organising self-data mode. For new players, it is essential to have a tutorial stage to instruct them how to play in each function shown on the main page (i.e. animation scenarios, navigation mouse, and instructional text). For instance, the designer might create a navigator spot shaped in the form of a hand, which leads new players to explore and investigate each function. Not only identifying how to play the game, it is also necessary in the design to exemplify consequences that will occur, based on playing performance, to show new players how the game's mechanics are designed. Moreover, another consideration in the game's flow is the players' emotional state, which refers to how the flow of the game tends to trigger emotions at each stage.

In Image 7.2 below, player emotions have been summed up with the expectation that the player will engage with the game, based on feedback from the earlier stage. In this design criteria section, five stages of player emotional triggers lie in the structured

model: storytelling, tutorial mode, exploring the game's world, mastering the game and maintenance. The previous statement is mainly focused on how the game-design elements promote child players' interactions and experiences, in terms of emotional nudging. However, the diabetic-coping regimen has to be harnessed into these stages of emotional flow as well. The activities for coping-with-diabetes constructed for this project, are based on our understanding of children's capability to learn therapeutic data and their cognitive development at ages five to six.
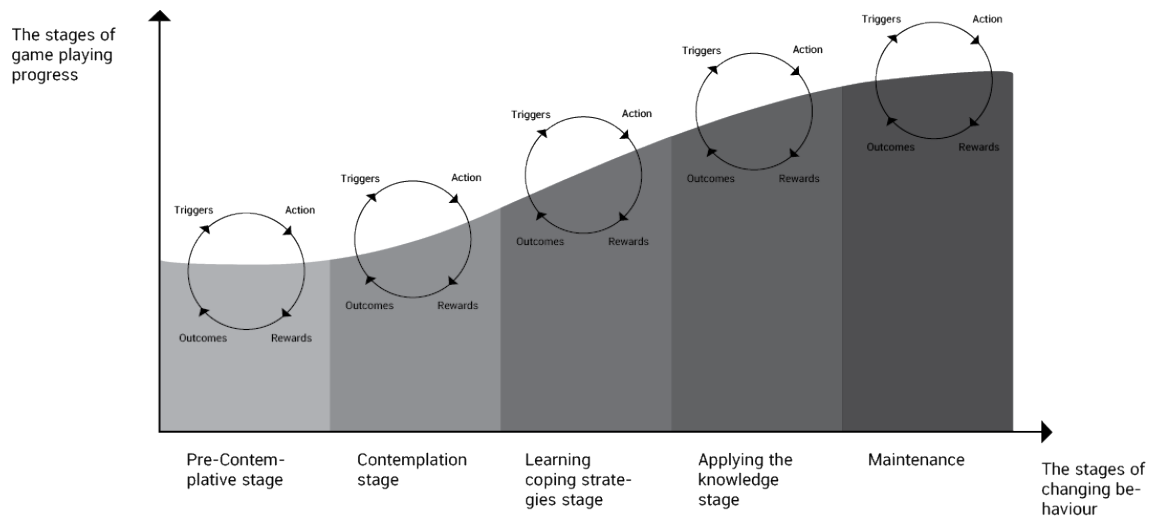
Figure 7.2 Game flow including coping-with-diabetes activities applied to the final design prototype (Klangpremjit, V., 2019)

From the diagram, the model developed in this section generates a game flow based on a sequence of player's emotions including coping activities suitable for this age group.

Design guideline 3: Designing the game's appearance

According to the players' response to the garden game, its similarity with educational media, and its naivety were reported as being not attractive to the participating children. Based on this feedback, four sub-categories were identified to help define the mood and tone of the children's game, as shown in the bullet points below:

- Balancing graphical aesthetics to appeal to both genders;
- Simplifying reality;
- Balancing mature game appeal and childlike graphical appearance.

From the previously defined criteria, using a vivid colour scheme to attract child players may give it a too childlike appearance, indicating that the gardening game represented a non-challenging game. Due to this feedback, the game's aesthetic was reconsidered,

based on the bullet points above. Firstly, to find content that would appeal to both genders, the designer explored children's media commonly perceived as unisex child content within Thai society – i.e. suitable for both genders. Almost all of the cartoon characters that appeal to both genders (N=67) are designed by Disney, such as Mickey Mouse, Winnie the Pooh, and Donald Duck. Representing both genders in the game's GUI (Graphic User Interface) was recommended, along with a unisex colour scheme and a well-balanced tone. Secondly, the game's visual aesthetic should not be too childlike or too mature. The game should offer a balanced graphical appearance in which, distorted from real life, objects are balanced between cuteness and realism. The images below show a graphical appearance exemplifying graphics suitable for children at this age and for both genders.

Figure 7.3 *Example of visual graphics to engage targeted users in this study I (Dwan, H., 2017)*

Figure 7.4 *Example of visual graphics to engage targeted users in this study II (Disney Games Arcade, 2017)*

In this section, the graphical aesthetic is represented for the targeted users as balancing a childlike look with mature appeal, using fantasy elements and an energetic colour scheme.

Design guideline 4: Providing responsive feedback

The simple technique of making selections on the screen was emphasised as an anticipated tool, based on the participating children's interview data and observation data. The feedback informed the design to create a drag-and-drop selection, applied in the initial prototype, led to player confusion and complexity. A solution to this was considered for the next design, based on understanding five to six-year-old children's capabilities to interact with the screen system. The strategies commonly applied in interactive media targeting young children, demonstrated in the pedagogy, are: (1) drag-and drop-selection, (2) click-and-release selection, (3) hold-and-release selection, (4) free-handed selection, and (5) simple click and select (Mikhak et al., 1999; Wyeth and Purchase, 2003).

From the playtesting responses, other techniques for making on-screen selections were suggested as being more obviously involved with game design for the next version. Based on the fieldwork data, the navigation tool on the screen interface should be easy to hold and perceive. Moreover, the selected icon has to be distinguishable from other elements in the game's on-screen graphics. In addition, the navigation tool must change in appearance when being operated by the player (being clicked and released). This was seen as imperative, especially in light of young children's abilities, in order to provide responsive feedback in the form of clicking interaction. After the playtesting activity, the design criteria determined in this stage were gathered. These were categorised into three anticipated feedback signs, which are: (1) distinguishing the navigator tool on screen from other on-screen graphical elements, (2) having visual and audio effects to demonstrate that the navigation tool is in progress, and (3) being responsive to the player's actions.

Firstly, the navigator tool should clearly identity itself to be easy for the child to recognise. To distinguish the navigation tool from other elements, the tool can be designed to be a distinctive shape and illustrated with surrounding visual effects. Secondly, the player's actions can be differentiated by their shape when an element is selected or not selected, in order to make the child player aware of their progress as they make selections. Thirdly, the responsive feedback system, in the final game prototype, will show feedback signs in the form of two modes of response, which are visual signs and audio signs. The visual reflection graphic represents graphical elements displayed when the player's action successfully responds in the game system. For instance, the

navigation tool will change colour when the player has clicked on the screen, and change size to inform the player when it is released. Audio reflection focuses on the sound feedback incorporated into the visual feedback, to represent system responsiveness to player actions. These two modes represent the game's feedback to the player to state the player's status and progress when the system is operated, based on player interaction.

To conclude, these four new approaches to defining new design criteria were used as a set of navigators to steer the final design direction in the formulation of the persuasive diabetic game. This also narrows down effective diabetic game-design principles for a specific context, by delivering a meaningful gameplaying experience harvested from previous methods undertaken throughout this study. Now that the new approach has been demonstrated, the next section describes the game-design process for the next prototype game.

7.2) Rocket Ninja's design process

Design procedures undertaken at this stage of the design game prototype is divided into six sections: defining the gaming content; creating the gaming content; defining the gameaesthetic; defining the game mechanics; character design; and defining responsive feedback of interaction activities within the final game system.

Defining the gaming content

In this stage, the final prototype became a game simulation, as it is easy to adapt to the model stages of behavioural change in prototype mode. Additionally, the nonlinear storyline embedded in the game system does not distract the child from coping with their diabetic regimen — i.e. it is easy to apply to the coping experiences. To support this argument, the narrative storytelling of the game will distract the child to mainly focus on the game's storytelling, rather than on diabetic-coping strategies. Besides, the tradition of a linear narrative structure is based on the storyline of the main characters and the specific circumstances embedded within the games. As this tradition is hard to apply to diabetic-coping activities, the game's story should be flexible due to the schedule of insulin administration and sugar-balancing activities – i.e. those activities that lie within the daily life of a diabetic. Moreover, to enhance the player's creativity, this game simulation can enhance the player's feelings, as it allows them to be creative and create their own outcomes regarding game content, based on the motivational trigger recommended by the child participants from the fieldwork data.

Creating the gaming content

In the updated version of the game design, the game content had to be re-considered by understanding the design criteria mentioned in the earlier part, stating the importance of providing opportunities for the player's creativity, which ties in with the notion of escapism, as well as for relevance to the children's media in Thailand. From the feedback of the participant children, it was learned that the content that they see in their everyday lives does not appeal to them. This information contradicts information from their parents, who said that the game content should reflect educational media and be appropriate content for young children. Bearing in mind this contradiction, content was sought out that met both of these criteria – i.e. content different from educational media (from the child's perspective) and content relevant to educational media (from the parental perspective). At this point, it was imperative to define the children's media content that parents expect to see: (1) content to deliver knowledge to child players, while providing an entertaining experience, (2) content in accordance with the child's mental and physical development at age five to six, and (3) content that will not contain war, fighting or violence.

To respond to these requirements, first all the educational media that might be relevant to educational aspects was studied. Additionally, possibilities were sought out to integrate that kind of story with fantasy content. As stated previously on the selection of game storylines in the initial garden game design, options other than those that had previously been considered were included. There are five storylines in the game content, which are: garden content, cooking content, sport content, space content, and simulation of adult career content. The project selected the space and simulation of adult career content for the new design game, as it delivers child players with emotional stimuli, such as a sense of exploration, a fantasy world, content appealing to both genders, and a sense of escapism. Urging the player's emotional motivation to be triggered was not the only thing that was considered, but the content design also included relevant to parental expectations, and needed to be flexible enough to be applied to diabetic-coping activities. The table below demonstrates how the storylines were deliberately considered, based on the design criteria for diabetic games targeting young children.

Design criteria for the game storyline content				
Storyline content	**Appealing to both genders**	**Meets parents' expectations**	**Appealing design**	**Attractive storyline**
Garden content		X	X	X
Space content	X	X	X	X
Sport content		X	X	
Cooking content		X		
Career content		X		X

Table 7.2 *The design game storyline defined by the criteria (Klangpremjit, V., 2019)*

Understanding methods to define gaming content, mentioned above, helped to decide which storytelling content to apply within the game. Based on the above reasons, space content was used as the storyline for the final game prototype.

Defining the game's aesthetic

The game's visual design has five components, which are: graphic design interface, mood and tone of game design, character design, game's sphere aesthetic, and information design.

There are no specific studies or relevant research on young children's aesthetic preferences for serious game and learning software. Suspending judgement on visual aesthetics and preferences for early childhood capabilities in system interface interaction was considered as an option. It was also assumed that the final game prototype would be designed taking into account an aesthetic direction based on prerequisite professional design experience in this field.

To tackle the problem of research bias, three initial game graphic interfaces with different graphic stylists to offer to the child participants were designed to encourage children to discuss and compare different game visuals. Moreover, this method promoted responsive reactions from the interviewees who discussed their reasons for preferring their chosen style of graphic design over other options. At the beginning of the interview, during the graphic design stage, still images of each graphic design direction were introduced to each child participant to elicit their reaction to the image's appearance. This facilitated the isolation of the graphical design elements that the participant child liked or disliked in the images.

The study conducted interview fieldwork during the process of designing the game's aesthetic, with 20 non-diabetic children aged five to six years divided into three interview sessions (two groups of seven children and one group of 6-year-old children). In the first session, three images of design direction from the alternative styles were shown for feedback discussion, demonstrated below (Figures 7.5–7.7). The discussion during the interviews focused on general design aesthetics, readability of information, and interpretation of signs. An image for each design direction was shown to the interviewees and considerations, such as readability were discussed, and each responded to the form, size, and letter spacing of typeface; the graphic appearance was reflected in the colour scheme. Each image was shown to the interviewees at the same time as requesting feedback on the overall visual design. They were also asked specific questions about each element in that image to find out what they liked and disliked. The approach in this section was aimed at gleaning responses to each visual element, relying on participants' points of view, and their recommendations for improving the image's appeal. Once all three images had been presented to the children, they were asked to compare the images.

To recap: this second section has focused on the graphical appearance of the final prototype, which was developed based on the feedback from this first version. In this version, the prototype was mainly criticised due to the legibility of visual language applied within the diabetic game.

Figure 7.5 *The first image of graphic design direction* (Klangpremjit, V., 2019)

Figure 7.6 The second image of graphic design direction (Klangpremjit, V., 2019)

Figure 7.7 The third image of graphic design direction (Klangpremjit, V., 2019)

Data analysis: design of the game aesthetic

This section focuses on interpreting children's thoughts on the game aesthetic. All of the child interviewee statements and actions were captured during the game's graphic design phase interviews, and were interpreted and revised. The subsections below identify themes regarding the aesthetic of the game's graphics, to be applied to the final game prototype. This also includes a detailed discussion of the graphic design criteria that had been formulated, based on the understanding of participants' responses to the visual appearance of the diabetic health game.

Mood and tone of game design

More than half of the participating children reported that the game's art direction offered an aesthetic that mimicked a mature game, rather than a childlike design. This kind of comment was highlighted by the fact that most of the child participants (N=14),

selected image 3, which represented a balanced graphic appearance between a childlike and mature appearance. The mood and tone of this image was conveyed through simple shapes and more mature elements were embedded within the game's graphical design. The space game's world also reflected the space objects that the child normally sees in the education media regarding space content. In addition, this style of graphic attracted both genders (judging by feedback responses), and a large number of participants (N=16) chose the selected image. Hence, the art direction of image 7.7 was selected to help determine the mood and tone of the final game design.

In the final prototype, the art direction was separated into four major sections: (1) game's feature interface, (2) style of the game's character design, (3) navigational tool design direction, and (4) the game world's environment design. Figure 7.8 below identifies the art direction of the final game.

Figure 7.8 Mood board for prototype of final game (Klangpremjit, V., 2019)
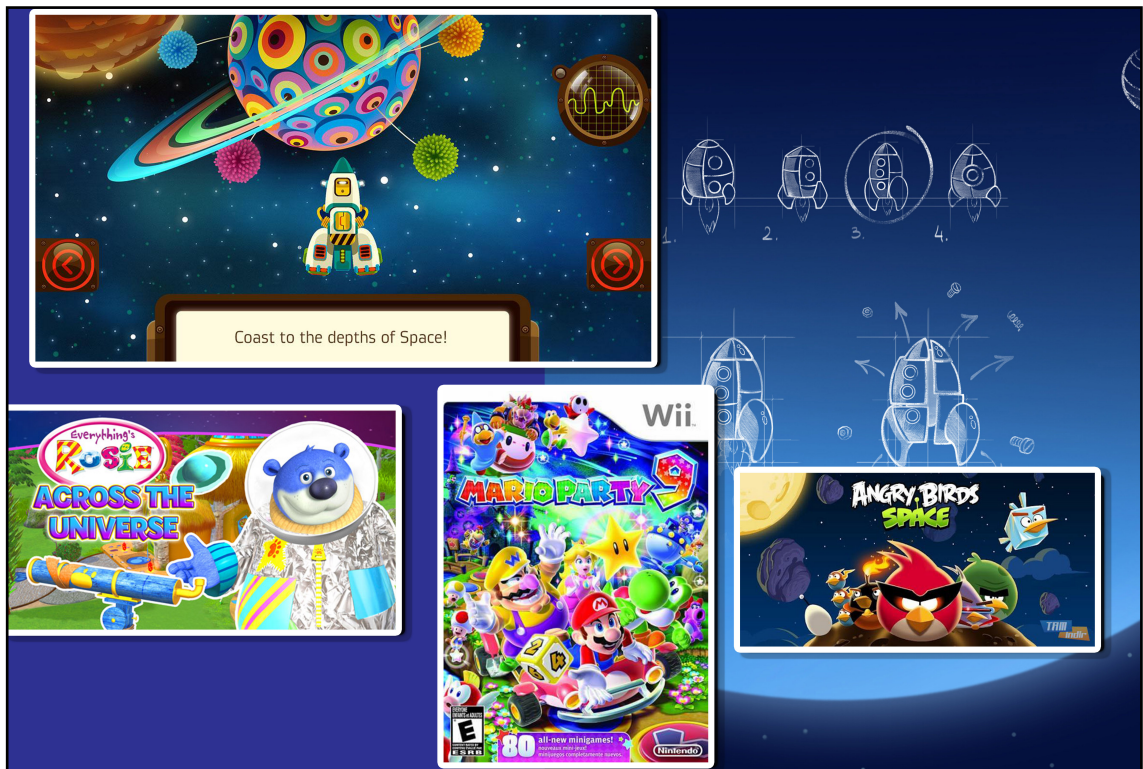
Figure 7.9 *Mood board for prototype of final game (Klangpremjit, V., 2019)*

In this stage, the considerations for designing a game interface spanned three subsections: text, sign, and glare. The length of the text within the game's interface was marked as the first aspect of concern. Therapeutic data was translated into the graphical imagery. The participants were also told that some superfluous information would appear in the game and needed to be recognised as coming from the gardening game. Moreover, some of the text relating to medical information was too overwhelming and too small to read. The key element of the participants' response regarding this section related to visualising the diabetic data. Secondly, sign – in the game prototype, three types of diabetic data needed to be constructed and translated into visuals and signs: (1) nutrition facts (food and medicine icons), (2) insulin intakes data and taking insulin procedures icons, and (3) exercise data (icon of taking exercise). The designed icons within the game were simplified into half-geometric shapes in order to be easy to interpret.
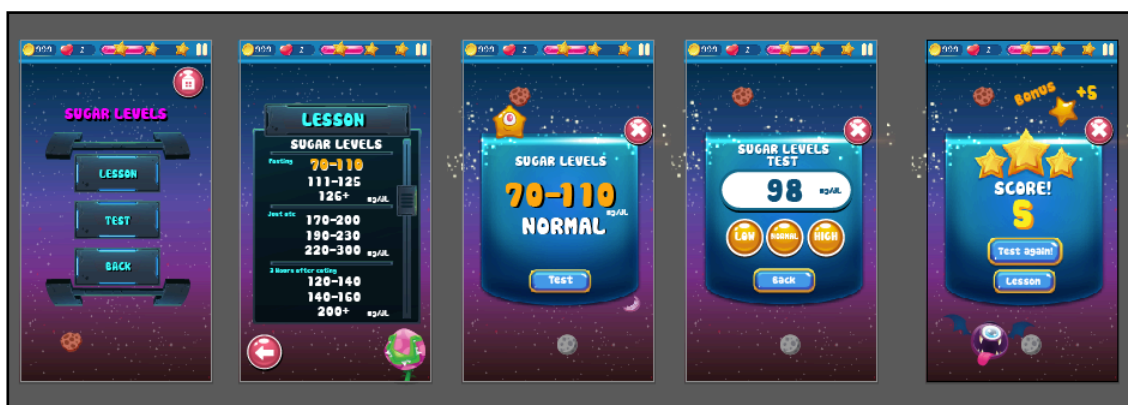
Figure 7.10 Example of instruction data designed in each function of the diabetic health game in this study
(Klangpremjit, V., 2019)

The design of the second prototype was concerned with ensuring that signs and icons regarding the diabetic data were balanced between simplified shapes and mature game icons. Lastly, glare – the size of the objects within the game was recommended to be amended, as they needed to be larger and some of the information was blended into the game's background in some features, and was difficult to read.

Style of character design

It is imperative to state at the beginning of this section that the term 'character design', in this game study, refers to every character element that will appear within the game's world including villain, main character, and virtual pets, rather than focusing only on the main character. According to the game simulation, character design is not the main game element, as the main element is the player with a first-person perspective. However, the player will still be provided with this feature, by creating their avatar to represent themselves, and placing it into some game features, such as score-board competition and diabetic data report features. Besides, creating a player's avatar can also give players a feeling of belonging and creativity through their avatar's costume and status.

The style of aesthetic, that was applied in the final game's characters include: line, shape of characters' ergonomics, the colour scheme, and the characters' emotional expressions. The art direction of character design within the game was meant to support energetic feelings and cuteness, as well as providing a mature appeal, a challenging look, and a hint of seriousness. During the first stage of designing the game's characters, conducted from 2014 to 2018, the context of designing characters in child media in Thailand was explored. A mood board was created to navigate the direction of the character design, as can be seen in the figures below.

Figure 7.11 -7.12 Mood board of character design for the prototype of the final game (Klangpremjit, V., 2019)

Two types of characters were created within the game world: a human characters and a non-human character. In designing the human character   a lifelike human ergonomic character was combined   with a simplified human figure. The images below identify sketches of the character design, informed by the defined criteria mentioned above, to seek out the most appropriate character aesthetic.
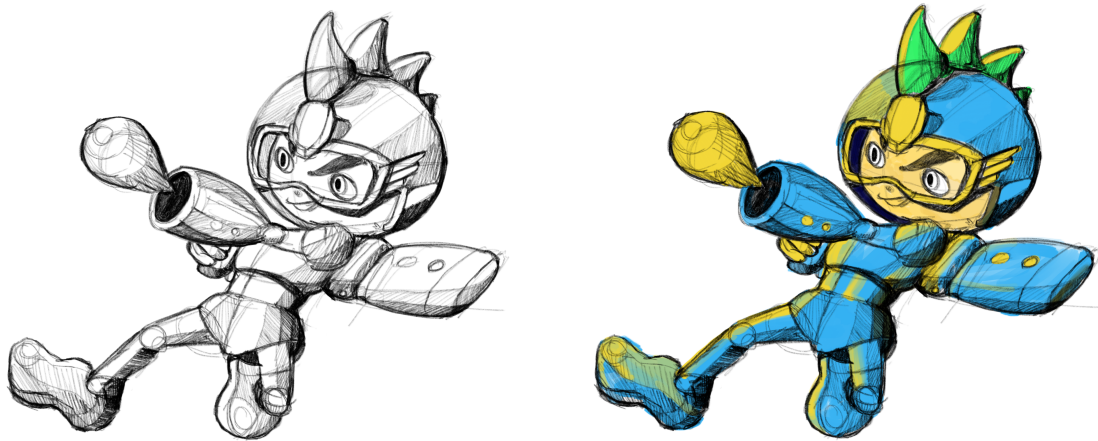
Figure 7.13 *Example of sketch of character design in the final game (Klangpremjit, V., 2019)*

To select the most appropriate character design for the final space game, the design criteria was defined to help choose: (1) an energetic feeling; (2) a colour scheme and line shape to represent an energetic look with cuteness at the same time; and (3) Visual of a lifelike space adventure experience. The images presented above demonstrate the method in which the criteria was developed to promote game's character design in the final game version.

Design game's environment

Another term for game environment is 'set design'. Herein we identify the set design as environmental design that aims to include every single element of the game's screen, relying on the game-design criterion mentioned earlier – that the game is intended to bring players into a fantasy world, through the concept of escapism. The first stage of designing a space world was investigating space games, in order to discover how the graphic design was represented within the games' world. The images 7.8-7.9 show the mood board, designed to navigate the mood and tone of scenes in the final game prototype.
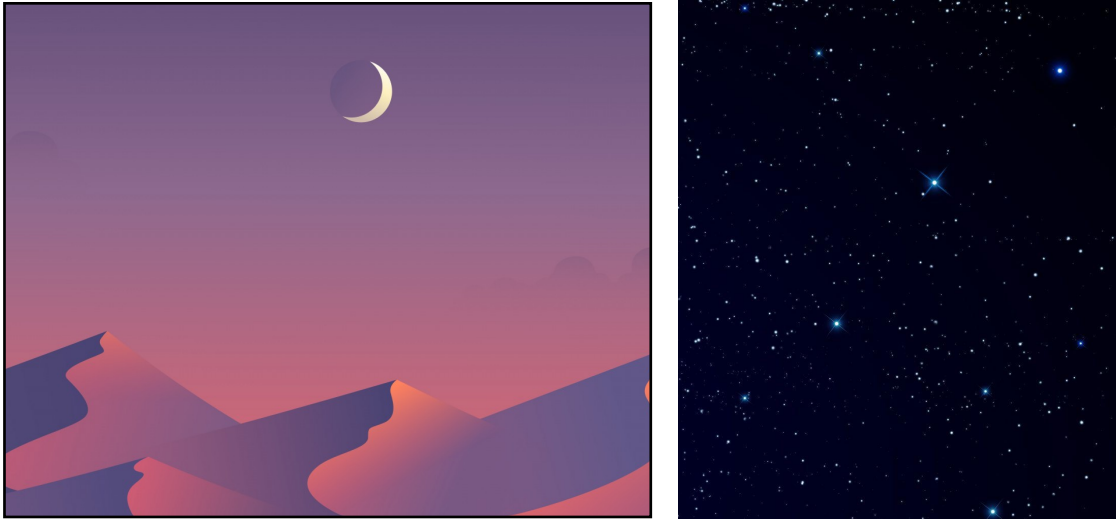
Figure 7.14 Examples of scene design (Klangpremjit, V., 2019)

In this stage, a set of characteristics of a planet was drafted, based on aesthetic design criteria which was: (1) having an energetic style; (2) balancing the simplified style of realistic and cartoon-like; and (3) providing a dynamic feeling. The mood and tone of the space environment within the game's sphere were represented to the target audience through cuteness and a vibrant look. The images below show the sketch design of the game world aesthetic, and the final look of the game.

Defining the game's mechanics

In this stage, the game's mechanics were developed from previous feedback of the initial game design, with the addition of knowledge gained from children's media influences. Previous feedback led to the identification of the criteria for the game's mechanisms. Data from players' feedback contributed to the design of the game's mechanics in the demonstrated in the a circle diagram as follows.
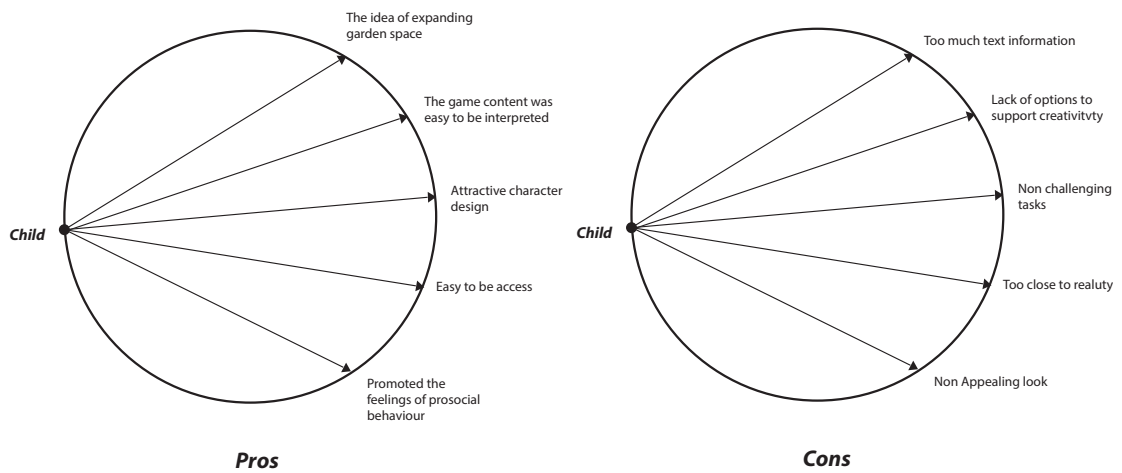
Pros

Cons

Figure 7.15 *Participants' feedback summarised in terms of pros and cons (Klangpremjit, V., 2019)*

The diagrams above helped to understand the problems that had occurred during the game play the initial game (Garden Tower). These problems identified the trouble spots and areas that needed to be amended and evaluated for the final prototype, which are represented in Figure 7.15 above, which illustrates the features that should be contained in the final game prototype. In this research, designing the core game mechanics was through these two strands. Through the aspect of motivational triggers mentioned previously, the data of game-design triggers from players' gaming feedback has been identified and divided into internal and external core drives, which were then applied to the final diabetic game. These two diagrams below visualise the defined player's triggers criteria, which were then applied to the final Rocket Ninja game.

Internal Triggers

External Triggers
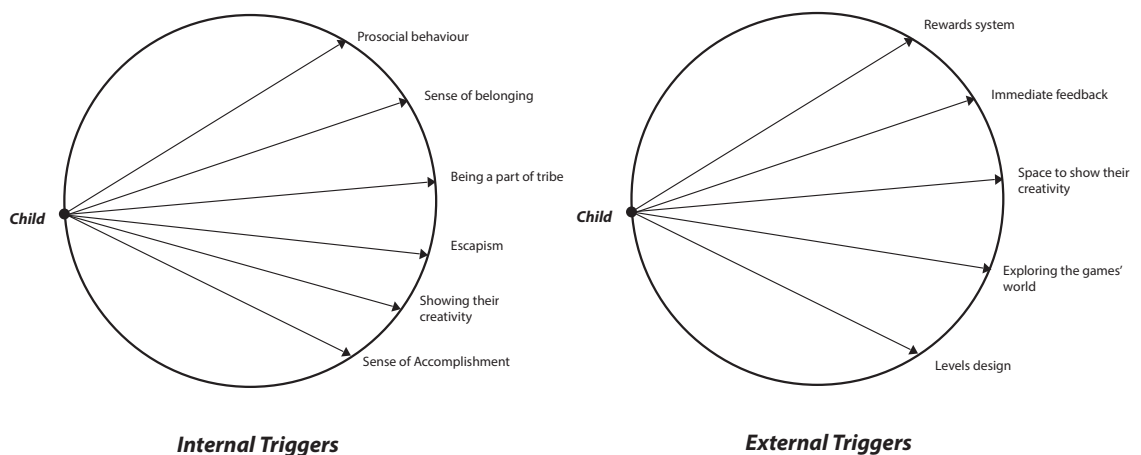
Figure 7.16 *The mechanics of initial game-design criteria divided into two types of motivational drive: internal and external (Klangpremjit, V., 2019)*

The figures above are simplified charts of the game mechanics, which have been adapted to the final game prototype – Rocket Ninja. After synthesising the players' feedback on the game's design mechanics, the set of mechanics for the design criteria was evaluated and presented as shown in the table below.
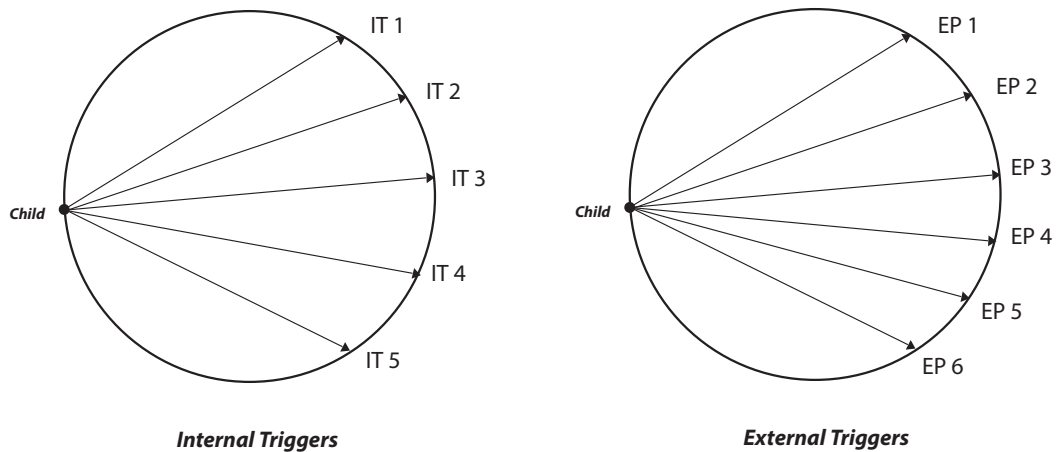
Figure 7.17 *Amended list of the game's mechanics, based on the player feedback from previous design procedures (Klangpremjit, V., 2019)*

IT. 1. = Providing archivable tasks
IT. 2. = Providing a feeling of creativity and an imaginary outcome
IT. 3. = Providing a sense of curiosity
IT. 4. = Providing a sense of exploration
IT. 5. = Providing a sense of belonging
EP. 1. = Customisation tool for the player
EP. 2. = Token and rewards system
EP. 3. = Virtual pet system
EP. 4. = Virtual world exploration
EP. 5. = Unlock and upgrade function feature
EP. 6. = Status representation system

As demonstrated in Chapter 6, p.169 (Playtesting responses), three main issues were raised at the game's evaluation stage: (1) the flow state of emotions, (2) rewards system, and (3) game's sequence. Hence, in this section, only three considerations of the eight elements of the game's mechanisms were selected. We can see from the diagrams above that these considerations were adapted by re-ordering the game's sequence, based on the players' requirements and their feedback on game interpretation within the storyline. This model mainly exhibits how the initial game used the emotional triggers to provide the player's emotional responses within each stage of gameplay. Based on this play

testing feedback, the state of player's emotional triggers in the model of behavioural change was rearranged as shown below.
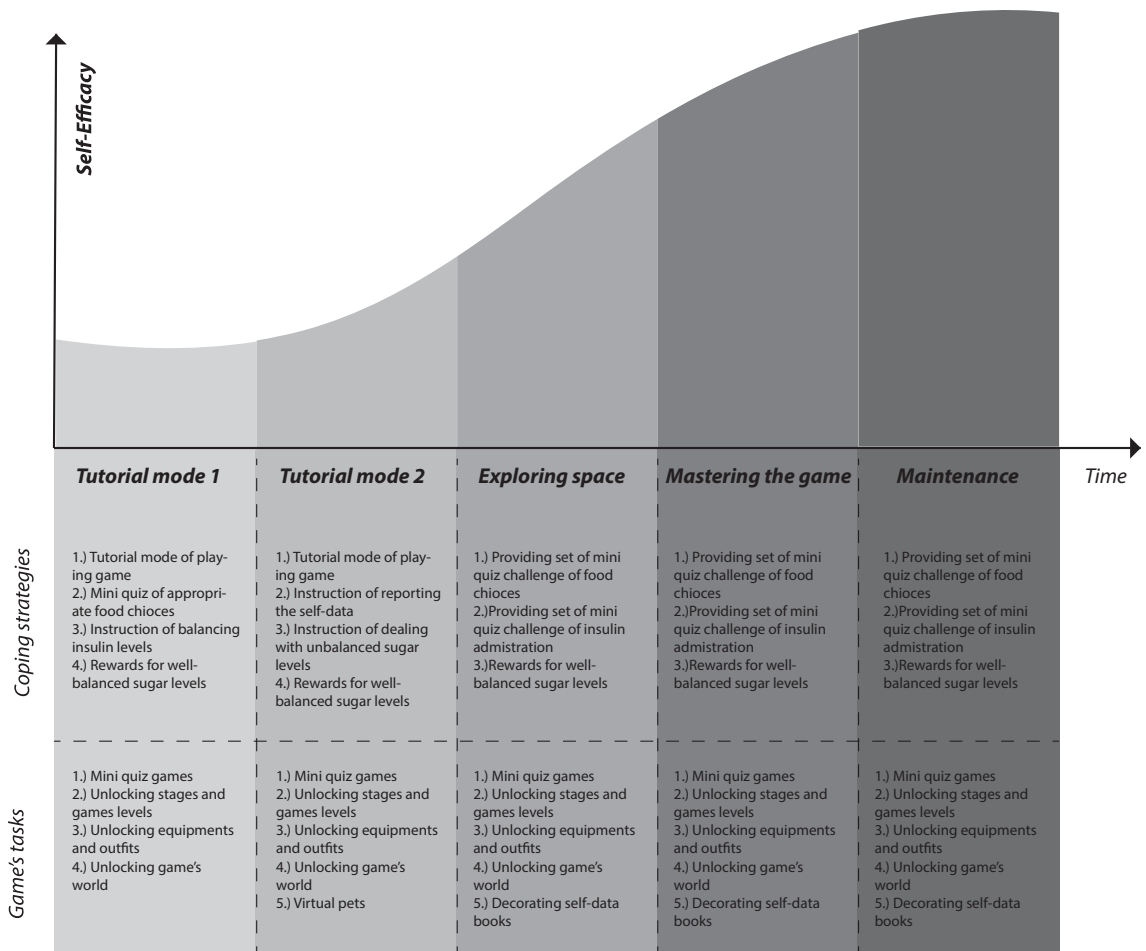
Figure 7.18 *The flow of player's motivational triggers determined in the final prototype (Klangpremjit, V., 2019)*

Figure 7.18 reveals that there are five stages of patient behavioural change determined through the game lifespan, divided into five modes of playing experience of this seemed same prototype: (1) space explorer storytelling, (2) learning playing as an astronaut, (3) space exploration, (4) being a game master and conquering the alien enemies, and (5) maintaining the power of the space empire.

Considering the time and budgetary limitations of this design research, it is important to state that both of two factors constrained the game's production, as the game was intended to be played within one month of testing and feedback. One month of final game lifespan   was determined, based on the fact that the pattern of diabetic player's behaviour needed to be tracked, in order to synthesise the game's results within the time limitations of this research period. Secondly, the participating diabetic children would

experience inconvenience if the fieldwork activity took a long time. Hence, it was decided that the demo of the final design game prototype be made instead of the full game, as it had to test the diabetic participants within this period. This final game was purposed to test with diabetic patient at this specific ages within 30 days to investigate how the game had helped diabetic child to constantly manage their treatment regimen.

1 Week	1 Week	1 Week	1 Week
Tutorial mode 1	*Tutorial mode 2*	*Exploring space*	*Mastering the game*

Figure 7.19 *The timeline applied within one month of design mechanics (Klangpremjit, V., 2019)*

Based on Figure 7.19, the game mechanics provided in the final game, developed within one month, can be detailed in Figure 7.20.

1 Week	1 Week	1 Week	1 Week
Tutorial mode 1	*Tutorial mode 2*	*Exploring space*	*Mastering the game*
1.) Mini quiz games 2.) Unlocking stages and games levels 3.) Unlocking equipments and outfits 4.) Unlocking game's world	1.) Mini quiz games 2.) Unlocking stages and games levels 3.) Unlocking equipments and outfits 4.) Unlocking game's world 5.) Virtual pets	1.) Mini quiz games 2.) Unlocking stages and games levels 3.) Unlocking equipments and outfits 4.) Unlocking game's world 5.) Decorating self-data books	1.) Mini quiz games 2.) Unlocking stages and games levels 3.) Unlocking equipments and outfits 4.) Unlocking game's world 5.) Decorating self-data books

Figure 7.20 *Game's triggers provided in the one-month game lifespan (Klangpremjit, V., 2019)*

Figure 7.21 Wireframe of Rocket Ninja (see the enlarged of final version in Appendix, C-5, pages, 398)
(Klangpremjit, V., 2019)

The rewards system determined at this stage was synthesised from the previous stage's feedback and earlier fieldwork data (including observation and focus group interview). In this second game, the player gains tokens and rewards, depending on diabetic-coping ,performance, constructed in the f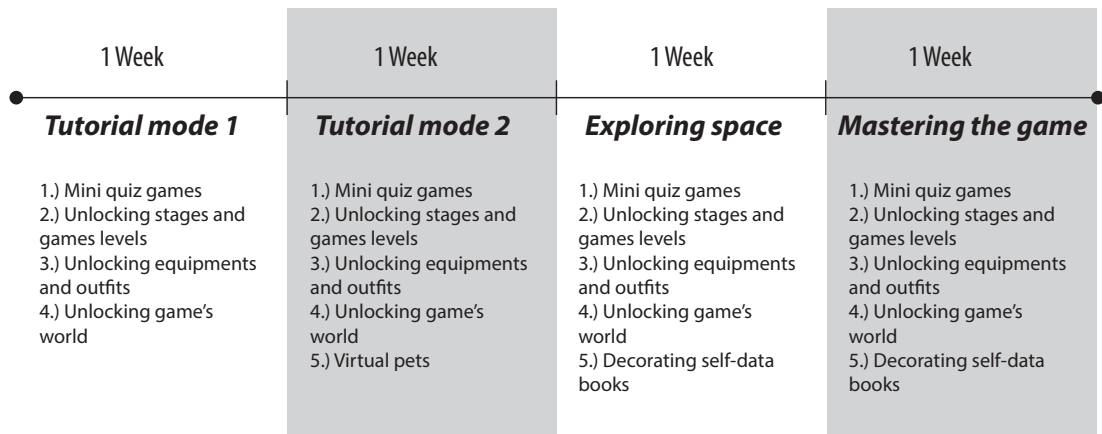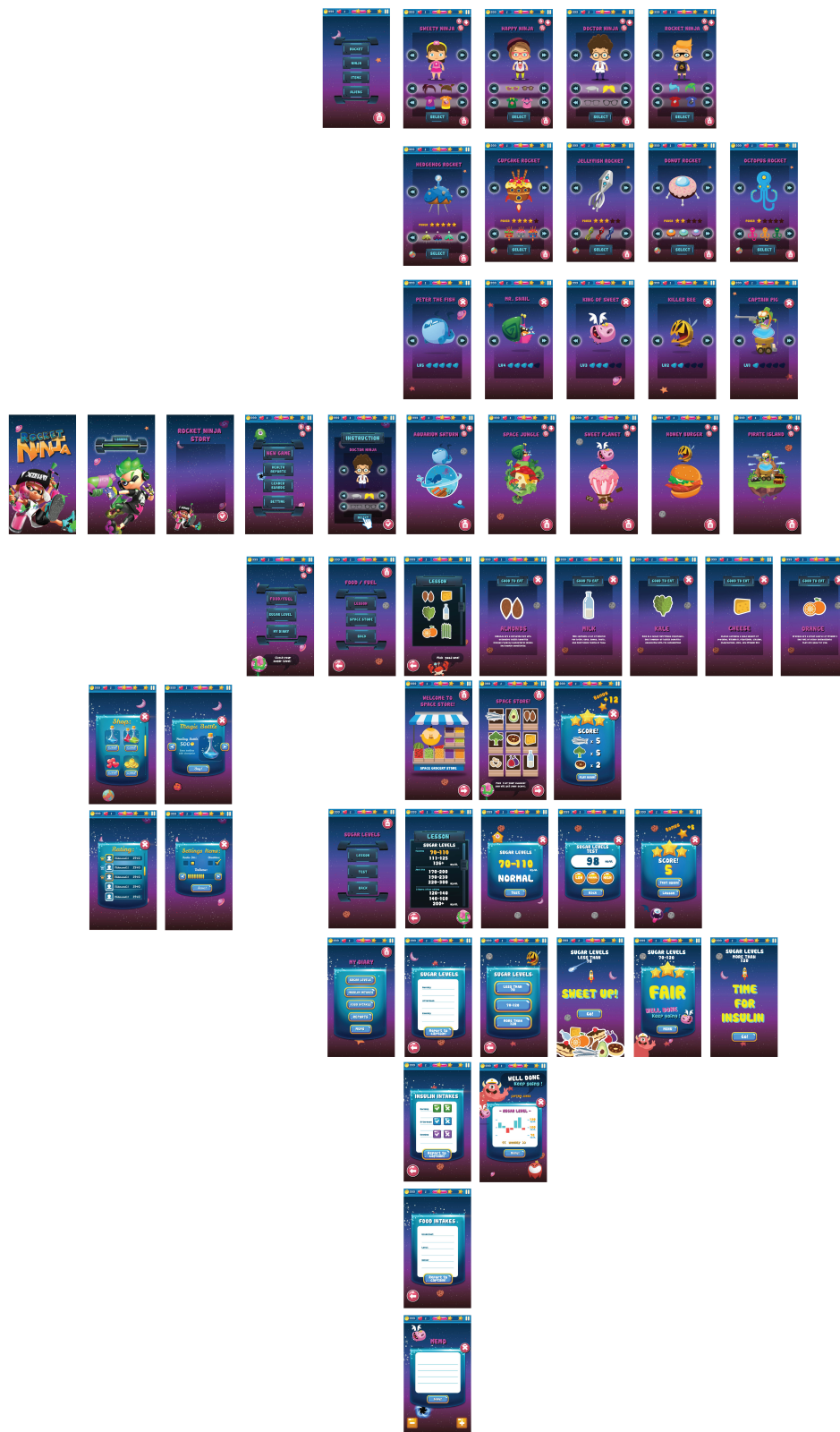orm of a mini-quiz challenge, mini quest, diabetic-report features, and consistency of balancing sugar levels. At the beginning stage of gameplay, the player gains rewards and tokens from simple tasks delivered within the tutorial section of the game. All tutorial tasks are aimed to instruct players on the game play mechanics and were used to encourage continuous playing through the rewards system. The four ways to gain tokens in this design prototype are: (1) finishing insulin administration; (2) completing mini-quiz games regarding appropriate food-intake information; (3) maintenance of sugar balance; and (4) constantly reporting coping activities including the food intake and insulin levels of the day. In addition, another form of rewards constructed in this prototype, is the badge system. In this final game badges are needed to show the player's progression and allow them to show their status to their caregivers. There are four statuses of player badges embedded within this game: Amateur Rocket, Novice Ninja, Intermediate Ninja, Professional Ninja, and Superb Ninja Warrior. These five, labelled badges are placed within each type of accomplishment, to encourage the player to pay attention.

Feedback from the initial game (Garden Tower) revealed a problem with the game-ordering sequence. This was amended within this design procedure. In this stage, the game's sequence was re-ordered to tackle and solve the problems participants experienced within the gardening game prototype. Figure 7.21 identifies the draft of the game's frame work in this final prototype. First, the main page of the final game directs the player to the space empire, with the icons on the main page, positioned in the corner of the page, as seen in the diagram.

In this Rocket Ninja game design, the sequence of game flow was put into logical order, and the children is immersed in the game world through the narrative which starts immediately in the first stage of gameplay. Creating the player's avatar was also done in the first phase of gameplay. Once the player created their avatar, tutorial mode was turned on to instruct the player on playing strategies, and on how to understand the basic diabetic information. After the player went through the first stage (tutorial mode), the main features of the game were presented on the main page, which also showed their progress: space library (diabetic instructional mode), space exploration (gaming mode), and space arena (organising data mode).

In Image 7.22, we can see that the game's structure was divided into three phases; phase 1 (the beginning stage), phase 2 (entering the game's world), and phase 3 (being a game master). The first phase includes narrative storytelling, tutorial mode, and creating the player's avatar. The second stage offers the player a set of game tasks, a mini-quiz challenge, and a set of game quests. The last stage is mainly targeted at engaging the player to continue playing, even when they have mastered the game.

Stage 1	Stage 2	Stage 3
1.) Story Line narrative 2.) Creating avatar 3.) Tutorial mode	1.) Quiz games 2.) Exploring games' world 3.) Decorating virtual stuff 4.) Reprting self-data	1.) Showing their creativity 2.) Looking after virtual pets
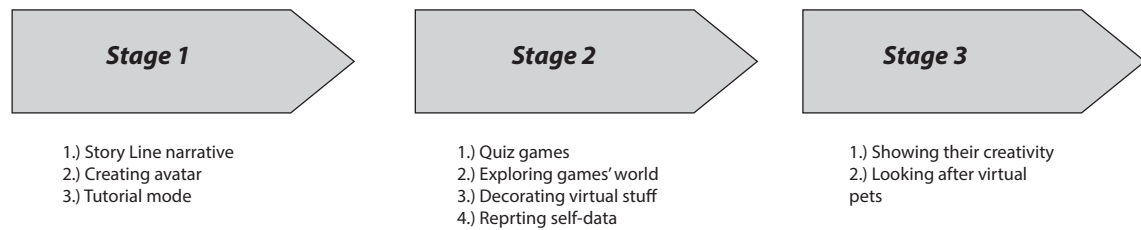
Figure 7.22 *The stages of game play that were constructed within the Rocket Ninja game (Klangpremjit, V., 2019)*

Character design

The character design aesthetic was previously discussed. In this section, focus was on the game characters, based on a broader perspective of the design discipline representing the player's immersive avatar. Characters within the game design are used to motivate the player to become integral to the game's sphere. Once the game's characters style has been designed and identified, their characteristics and personal traits were determined. Relying on the game's story, the player will receive a role within a ninja astronaut team, whose aim is to protect the world from alien invasion and expand humanity's empire. The player is surrounded with professional Ninja astronauts — for instance: Dr Marco, who specialises in aerospace engine mechanics who will help the player tackle the rocket engine problem; Steven, who is a professional aerospace geography technician, who will help the player to navigate the rocket. As a trainee in the game, the player has to progress as part of the ninja explorer team in order to achieve the space game's tasks, and the diabetic-management activities in their daily life.

In the game's first phase, Rocket Ninja game allows the player to create their avatar to represent themselves in the game world. The game customises the dressing up tool to stimulate their imagination in order to achieve the outcomes through their character design. The player's character represented within the game's virtual world, was designed using characteristics that were influenced by the design guidelines and cluster of playing motives mentioned in Chapter 4, p.100 (User Research). Providing the children playing with a sense of danger and excitement, along with cuteness, meant to enhance the child's interpretation of the challenging nature of the game.   Adapting

realistic objects, like weapons shown in a cute non-threatening mode can also amplify the appeal of the challenge. Image 7.23 below exemplify how the game's characters were designed to be more attractive for the targeted users.

Figure 7.23 *Character design offers a sense of mischief while delivering cuteness (Klangpremjit, V., 2019)*

Moreover, the design elements, which represent the characters using weapons and their power in terms of fighting abilities, were depicted as distortions of the real-life forms of these objects. This style of weapon representation in this game aimed to reduce the appeal of violence for child players, to meet the design requirement. However, fighting content was still offered, as it is appealing to young children. This prototype softened down representation of using weapons into something more delightful in the form of magical power. The figures below identify how the game's objects were designed within this rocket game prototype.
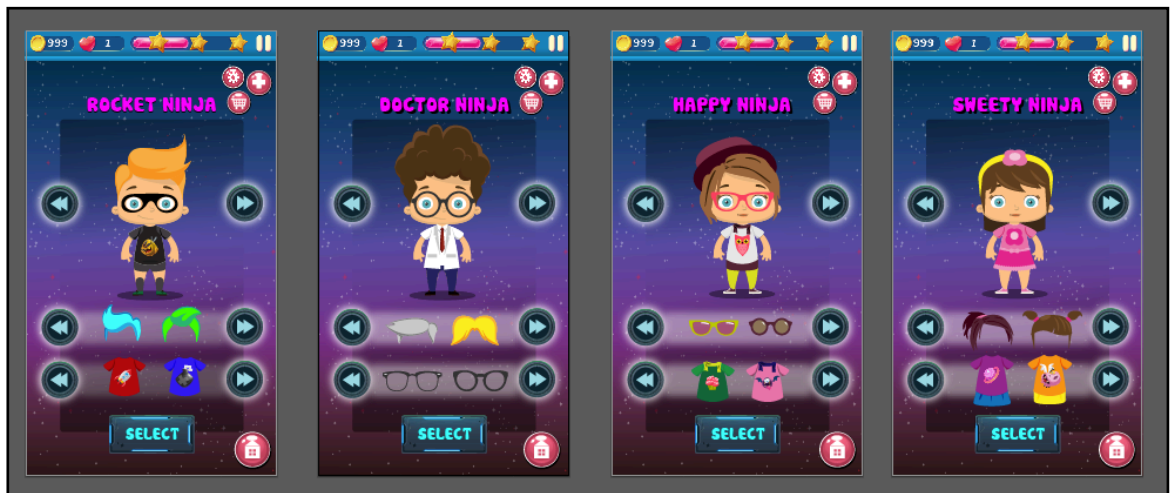
Figure 7.24 *Character design in Rocket Ninja game prototype (Klangpremjit, V., 2019)*

Defining responsive feedback of interaction activities within the final game system

The project divided the types of interaction activities into three main categories: (1) making the selection on-screen, (2) visual feedback on screen, and (3) audio feedback. The game's system is operated by the player through these categories. Firstly, making a selection on-screen is determined as a simple click-and-release technique, because this technique was identified as the most convenient for this age group. The visual effects to represent the reflex of player interaction with the game system have been highlighted in this design stage. Two types of player reflection were defined: the reflection before player operation and the reflection after player operation. Image 7.25 illustrate examples of visual effects to represent the distinction in navigation tools between before and after operation.
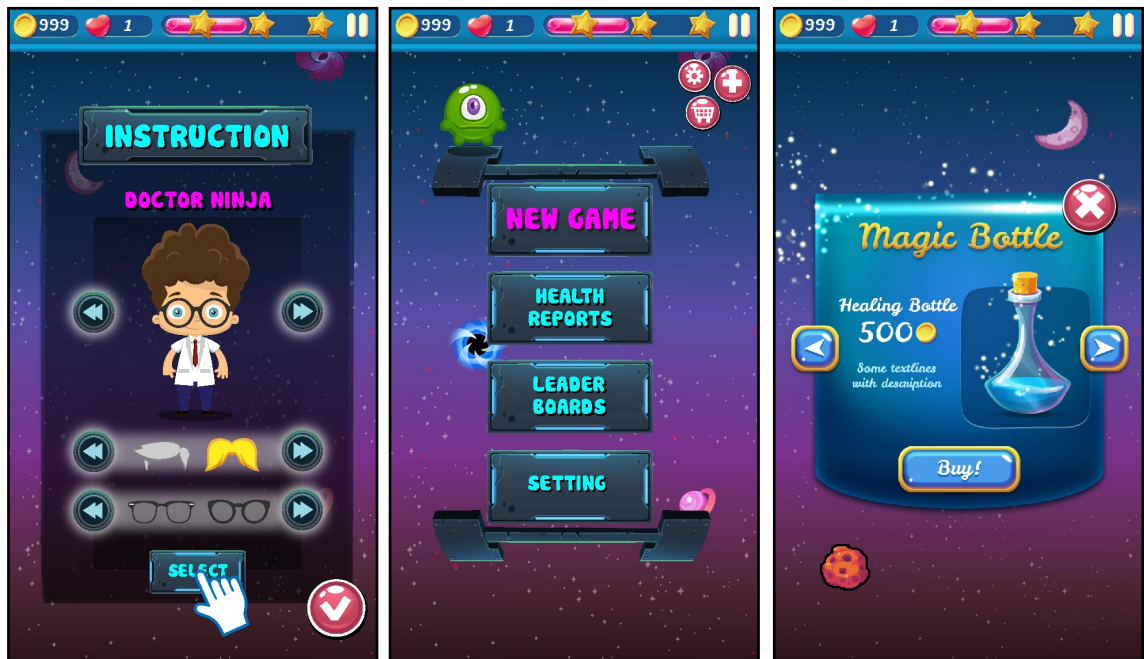
Figure 7.25 *Icons and navigation tool designed to represent the reflection of player interaction in the game's system (Klangpremjit, V., 2019)*

Furthermore, sound and audio response effects were considered and defined at this stage of game design. The audio-response feature was designed to stimulate the player's emotions to create an immersive experience within the game's world. The player's emotions were triggered in each stage, urged by the audio effects, to reflect the game's responsiveness. Suitable background music was selected to complement the game's storyline.

Design conclusion remarks

The six stages of the final game-design prototype were discussed in detail in the previous section. Each element was constructed based on literature studies and fieldwork data. The overall concept of the initial design comprehension (Garden Tower) has been synthesised and amended in the evaluation stage. Thus, based on prerequisite experience, if the game's storyline needed to be changed, this meant that the overall diabetic game design also had to be altered. Space game content was selected to portray a challenging game, as space was the most relevant to the content criteria defined at the beginning of this second design process.

Rocket Ninja is a diabetic health game that helps diabetic children aged five to six years and caregivers to manage their coping activities in their daily routines. The child player is immersed in a space game world as part of a team of ninja astronauts, who set out to protect the world from alien invasion and expand humanity's work to seek other resources. To be a master explorer of outer space, the player has to constantly cope with

their diabetic management, to gain more abilities and effective weapons, to conquer the enemies, at each the stage of gameplay. In every stage of conquering planet, the player and their pet avatar experience features that encourage them to finish that stage and graduate to the next. The player has to look after their pet to maintain its fighting abilities and enhance their skills, as well as fighting the aliens on each planet.

The design steps undertaken in the final stage of game design research are summarised in the list below.

1. The game's narrative, outlined in the final game content, emerged from the summarised data of the initial test design analysis based on the design criteria, which stated that the game had to reflect these notions: (1) being part of tribe, (2) relevant to educational media content, (3) escape from their reality, and (4) appeal to both genders.

2. The genre of this game has been selected by synthesising the criteria, and by re-visualising the concept of fighting into the softened direction of visual representation that meets parents' expectations regarding appropriate content for children of this age.

3. The character design content was not considered the main part of the Rocket Ninja game, because the game would be represented through the player's perspective throughout. However, the avatar creation feature was constructed in this game to promote the player's immersive experience within the virtual world. Various options for customising the avatar tool to promote the players' creative skills were created to represent themselves in the game space world (Figure 7.38).

4. Designing the game's mechanics within this final game is imperative to understand the game's elements that constitute the meaning of the gameplaying experience to the child player. The game's mechanics that needed to be amended in this stage were: flow of player's state of emotions, the rewards system, and game flow (game sequence).

5. There are five stages of diabetic patient behavioural change interlacing with the stage of game flow underlined in this study: (1) the beginning stage – the stage in which the game's story is narrated to immerse the player through the game's trigger of sparking the player's sense of curiosity; (2) the tutorial mode, which includes creating the game's avatar, instructional mode of game playing, and teaching the basics of coping with diabetic information; (3) the stage of exploring space focuses on nudging the player to instantly cope with their diabetic condition; (4) the stage of expanding the player's empire, which refers to the phase that allows the player to keep engaged with the game's system by providing continuous triggers within the game's world; (5) the maintenance stage, which focuses on the game's mechanics

that keep the player sticking with the game by promoting a sense of exploration, showing their creativity and curiosity.

6. To provide a meaningful response to player feedback about interaction, the project determined three types of feedback: (1) an audio system, (2) a visual feedback representation, and (3) re-creation of making selections on the screen.

Once all of these data were determined, the researcher embarked on the final game model production to test the game function and also understand the diabetic players' response. Comprehending their response at this stage can help validate the game's design principles, emphasising effective game-design strategies for the targeted players, since the objective of this research is to investigate factors to encourage diabetic children to experience good outcomes. In this study, exploring the game production was not the main concern due to the objective that focused on the game-design architecture from the perspective of the game design. To test how this final game works for the child player, the game was tested with diabetic participants in Thailand in July 2018. The detail of the test-design activity to gain final feedback from diabetic children will be discussed in the next section.

7.3 Final game play testing

As with the previous stage of gaining test design feedback, qualitative research methodology was applied in this playtesting stage through the method of case study research. To understand the diabetic five or six-year old child's reaction to playing this game, the case study method was selected as the tool, due to the low number of targeted users in this research. Also, the case study method allows the researcher to investigate specific data. The project illustrated the research's parameters to conduct the study within a set period in an urban area in Thailand where diabetic families can easily access digital technologies and facilities in healthcare services. The special properties of qualitative research methodology are highlighted in contextual studies on phenomenology interpretation, emphasised within medical pedagogy. This method is highlighted as it is appropriate for the specific area of knowledge in which there is a distinct lack of comprehension among game scholars (Leeds and Ormond, 2017, pp. 137–138).

Test design activities

As stated above, the qualitative study research approach is applied to gather insights into players' feedback on playing the prototype of the game. The research determined objectives for testing the design to define diabetic game-design principles from player feedback. The questions asked of child players are summarised in the following table.

Objectives of testing design activities based on game-design element standpoint	
Game's mechanics standpoint	- Is the final game's story attractive to the child player straightaway? - Is the technique of non-linear narrative engaging to the child player? - Do the characters in the game represent players' selves in the game's universe? - Does the flow of player emotions engage the player? What are their recommendations? - Is the flow sequence of the final game appropriate for the player and not lead to player confusion?
Game's interaction activities	- Does the final game provide players with feedback? - Is the on-screen selection-making technique suitable for children aged five to six years? - Is the game offered a proper size and is the glare appropriate for the player? - Is the design of the game's reflex well interpreted for child players?
Game's aesthetic	- Is the game's visual aesthetic appealing to the player? - Are the child players engaged with the game world's aesthetic? - Is the character design within the game attractive to players straightaway? - Is the final game's mood and tone suitable for children at this age from the point of view of their parents?
Culture context	- Is the game's content appealing to the child player? - Is the game appropriate from the parents' perspective? - Are players playing without hesitation? - Is the game's content appropriate for the Thai context?

Figure 7.3 Objectives of testing design activities (Klangpremjit, V., 2019)

The process of playtesting defined in this section included in-depth interview and observation methods. The semi-structured interview method was undertaken while the diabetic child was observed playing the game. The testing activities started by sending a consent form to five Thai families who had a diabetic child between the age of five to six years. They were asked to give their permission for the researcher to visit *(Appendix A-2)*. The researcher sent the consent form to 14 families, gaining their contact details from previous diabetic participants contacted in 2016. Once the diabetic children and their families had accepted the consent form, and one month before home visiting, each diabetic child was sent a demo version of 'Rocket Ninja' to let them test the game. This one month of testing was to gain feedback from the participants and interpret their progress in diabetic behaviour within the period of playing the game. After participants tested the game, the researcher visited each participant's home to conduct a semi-structured interview on the playing experience to find out whether it had helped them manage their condition in their daily life.

Five diabetic patients agreed to participate in this testing stage, comprising three girls and two boys aged five to six years and based in the urban area of Bangkok. The case study method applied in this procedure provided an understanding of player responses on the gameplaying features based on each design element through the player's feelings regarding each function of the game prototype. This case study constituted semi-structured interviews and observations with five diabetic children and their families to demonstrate how the game system interacts with child players and what elements were a problem for the participating players. The reason for changing to new participants at this stage was because previous diabetic participants involved in the initial test design study were now too old for the targeted age for this study. Consequently, a new group of type-1 diabetic children had to be contacted. The five diabetic children and their families who agreed to participate were interested in improving patient experience of diabetic children coping with the condition via the tool of serious game mechanics. The consent form contained details of the fieldwork as well as game playing instructions. To allow the players to test the demo of Rocket Ninja, the researcher uploaded the game demo on the website, and they downloaded it onto their mobile device or onto their desktop using Chrome. Then the participants commented on the game and reported to the researcher (through the interview) after they had played the demo game.

Once the participants had played the demo game, the researcher was permitted by the participants to observe each child's playing of the interactive game for one day. The insights gained provided information about the playing responses on some of the game's design elements while some elements had to be amplified by using in-depth interview data. The next section of the chapter will discuss the case study research process undertaken for final playtesting.

Building rapport with child participants

During the fieldwork, the aspect of building rapport between researcher and participant has been emphasized in pedagogy research to optimise the fieldwork environment and enhance the participants' response. To allow interviewees to feel free to give accurate feedback on the game, it was necessary to build rapport between interviewee and child participants. As a consequence, the feedback of playtesting was based on two distinct phases. In the first phase the interviewee spent time with the child to build rapport and in the second phase the interviewee visited the child to gain the child's response to the game. The first visit took place at the participant's home environment where they felt comfortable. As an ice-breaker, the researcher used toys and physical games, and talked to them about their interests (such as games, comics, and cartoons) to encourage them to respond to the interviewee. This method encouraged them to open their mind during the research fieldwork.

Methods of case study

Gaining feedback from targeted players was achieved through the case study research tradition. The methods of semi-structured interview and observation were used in this research stage. Firstly, an interview was undertaken to find answers to a set of questions that aimed to elicit the player's responses to each game-design element, outlined in Table 7.3 above. This led to the formulation of a set of interview questions for these participants in the interview session. There were two types of interview participants identified at this stage: caregivers and diabetic children aged five to six years. The set of questions for the caregivers mostly focused on how they thought the game elements had helped their child and how the game helped them to cooperate with diabetic management. The set of interview questions for the diabetic child aimed at understanding how the final game works and which game elements persuaded them to play the game. Five questions constituted the basis of the caregiver interviews:

1) How has this game supported your child in coping with diabetic management in their daily life?
2) What was the benefit of playing this diabetic game?
3) What were the weak areas of the final game in promoting their coping activities?
4) What was the progression of diabetic behavioural change during and after playing the game?
5) Do you have any recommendations regarding the cooperation features of diabetic management in the game's features?

For the diabetic child interviewees, there were four questions:

1) What parts of the final game persuaded you to play?
2) What elements did not persuade you to play?
3) Has this game helped you manage your diabetes?
4) What do you think would make the game even better?

Secondly, the observation method was used while the diabetic child was playing the final game. The families agreed to allow me to observe their child from 9 am to 4 pm on a weekend. I used video recording and photographs to capture the child's behaviour while playing the final game. This visual evidence, on reflection, supported insights into behavioural change through the game's elements. In addition, it can be used to support the information gathered in interviews regarding the gameplaying experience to promote diabetic management and can also be decoded to synthesise the meanings behind playing actions after the fieldwork has been conducted. Another important reason for having visual evidence of observations is that it can support our

understanding of body and non-verbal language such as facial expressions and body movements.

Lastly, after gathering the fieldwork data, the researcher synthesised and analysed the data from caregivers and diabetic children by transcribing significant statements. Rather than relying on one source of interview data, non-verbal language observed during the interviews via the N-vivo was captured using both video and audio files simultaneously. A primary concern while recording the video with the participating children was privacy. The camera was placed in a discrete location in the room where the fieldwork was conducted. The video was recorded when the diabetic child was playing the final game and being interviewed. The length of the video recording depended on how long each participant played the game and responded to the interview. The average video length was 40 minutes per child.

Case study data analysis

Based on the previously mentioned data analysis method, interview transcriptions and observations were used to interpret players' feedback by using the method of qualitative content analysis similar to the previous stages. The detail of data content analysis has been discussed in chapter 3 (Data analysis), in which the significant data was analysed and then categorised into main themes. The table below exemplifies how the significant data was categorised and interpreted in this design stage. Moreover, this table indicates the data of one diabetic participant to show readers how data was used in the test-design feedback data-analysis stage.

Interview data analysis			
Significant statement	**Meaning**	**Cluster**	**Theme**
'I love the way that I can win and collect the alien pet.'	They were engaged with the belonging features and customising things.	Owning the avatar stuff and modifying it.	Feeling of belonging
'I should get more scores for taking care of myself.'	Children did not think that the game was easy for them.	Too hard to achieve the tokens to gain the rewards.	Balancing of game's economy
'It would be great if I could really interact with another diabetic child.'	They wanted to show their coping progression with another diabetic child.	Interact with the other diabetic patients in a real-life social circle.	Social impact
"I want to show them (friends) that I am good"	They have stated the importance of being part of their tribe.	Being part of a tribe.	Social impact

Table 7.4 Example of interview data analysis of one diabetic participant (Klangpremjit, V., 2019)

The table above refers to the data analysis of the interviews conducted with the diabetic children and their caregivers. As stated above, the interview information was not the only information of concern in this study. Data regarding non-verbal evidence was also considered at this stage of data analysis. As with the interview data analysis, significant statements were underlined to interpret meanings behind players' actions based on each element of the game-design system. The table below shows how the observation data was manipulated to amplify the player's feedback.

Observation data analysis			
Significant statement	*Meaning*	*Cluster*	*Theme*
The child found making the on-screen selection easier to operate.	The flow of the final game design was not confusing to the child player and promoted engagement.	Redesign game's flow sequence.	Flow state of player's action
The child kept looking for more tasks to play within the game.	A lack of tasks to challenge the player in the final game.	Create more challenging tasks.	Task's complexity
The child tried to find out more options to gain the tokens.	They wanted to show the diabetic-coping progression with another diabetic child.	The game supposed to have a feature allowing interaction between players.	Social impact
The child seemed to be impressed by the new arrangement of the game sequence.	They have stated the importance of being part of a tribe.	Redesign of game's flow sequence.	Flow state of player's action

Table 7.5 Example of observation data analysis of one diabetic participant (Klangpremjit, V., 2019)

With reference to the table above, this data was taken from test design fieldwork studies and synthesised in this section. The feedback of each participant from this design and the initial garden game was compared after this stage of data analysis. The project presented data from each participant along with the participant's medical background to see how they coped with their condition after playing the Rocket Ninja game for one month and testing the design elements. Comparing the two prototype games in this study gave us an understanding of the game-design progress employed at the stage of game-design procedures, helping us define which game elements could be used to persuade players and which ones could not.

The next section presents diabetic participants' feedback in order to comprehend their perspectives on playing the rocket game.

Results of the Test design

This section is divided into three main parts: (1) summarising each participant's response to using the rocket game design; (2) summarising themes in regard to player feedback about persuasive elements in this game design; (3) collating the players' feedback between this rocket game prototype and the initial design prototype. The first subsection starts by providing an overview of gameplaying responses to the rocket game, understood through the lens of qualitative content analysis. The second part

provides data of player's recommendations on the diabetic game's design elements including mechanics, interaction activities, aesthetics, and culture context. The third part presents a comparison of players' feedback on both game prototypes to clarify the appropriateness of using game strategies to engage diabetic players.

1.) Diabetic child participants' feedback on final game: In this subsection, the researcher summarised each participant's feedback, after playing the rocket game over one month, in the form of significant statements. These themes of players' motivation illustrate the factors for internal triggers within this health game for young children. The insights in this area of comprehension demonstrate the design criteria of the game's triggers embedded within the game's system such as aesthetic feedback, players' emotions, defying the game flow, and game content. The analysed data in the section below indicates a similar concept of players' perspectives regarding persuasive game triggers and their anticipation in future diabetic games for young children, to the theme of previous test design results. The table below demonstrates the details of each participant's response to using the game to deal with their diabetic experience in their daily regime.

Participant A
'A' is a five years old child. He lives with his mother and father in the urban area of Bangkok. His parents work in the central area of the city, which means that he has to go to school early (6 in the morning). Because his parents work, 'A' has to rely on his teacher to help him manage his diabetic condition while he is at school. The report of this participant shows evidence that 'A' played Rocket Ninja almost every day over a one-month test and also reported his daily diabetic status to his caregivers through the game's mode. He told me that the main thing that motivated him to constantly report his status was the rewards system, which allowed him to increase his ability in the space content via the exploration feature, buying more stuff and weapons, and looking after his virtual pets. He also mentioned that the game did not provide him with a real-world connection to be able to make him feel a part of society (he means his non-diabetic friends) and another diabetic child through the game's fantasy world. This was confirmed by his caregivers who mentioned that the child had anticipated showing his progress not only to his caregivers but also to friends through social media. Based on observations and parents' interview information, 'A' found it easy to play Rocket Ninja without any instructions. However, some parts of the game still were confusing to this player — for instance, he had to wait for the insulin-administration time in order to have a chance to gain the tokens. The most frequently visited feature within the game's system was the mini-quiz challenge which allowed him to select appropriate food choices for a type-1 diabetic patient. He often played with the mini games embedded as sub-tasks in this final game so as to extend his avatar abilities in the game's world. In addition, the child wanted to see the mystery box at the end of the day. He said he wanted some unexpected events and surprises, while coping with his diabetic condition. The child's mother reported that she was quite impressed with this game's trigger to persuade the child to report his daily data, as the child expected to see the outcome based on his health-management action. In spite of this feature working well for the child, the game still needed to offer more tasks in the mini quiz to challenge him. 'A' said the mini quiz was too easy for him and too short. Based on the teacher's taking a big part in diabetic management in his school life, the function of reporting the diabetic child's daily results helped him reduce his parents' anxiety about his ability to cope with his condition. The parents suggested that the game needed to be operated via an online platform such as Facebook, Twitter or an online game such as a Millie app, in order to update real-time status.
Pros: 1.) The content of Rocket Ninja was appropriate for this child's development. 2.) The child was motivated to cope with his treatment regimen, steered by the games elements of Rocket Ninja storytelling, game's flow, virtual avatar and pets feature, and design game's aesthetic. 3.) The child reported his condition status daily as he expected to gain feedback from his caregivers to receive the tokens to validate him and to increase his gameplaying abilities.
Cons: 1.) The rewards system within the rocket game was not well balanced; the child said that it was too low compared to other games. 2.) Some visual signs and images were not easy for him to interpret. 3.) There's lack of options to be chosen for creativity purposes.

Table 7.6 Participant A's feedback on Rocket Ninja noted in the research (Klangpremjit, V., 2019)

Participant B
'B' is five and a half years old, living with her father, mother, and grandmother. Her parents work in the central area of Bangkok and allow her grandmother to take care of her diabetes condition. Their extended family lives in the countryside, but because of the child's condition, the parents had to find someone to help them and so the grandmother moved from the countryside to Bangkok to help her granddaughter cope with diabetes management when her parents are at work. Her grandmother has to go to school with her in order to administer the insulin for her since they do not trust the school staff. The school does not take responsibility in any circumstances for the coping regimen. As a consequence, her grandmother has to go to the school twice a day, at 9 o'clock in the morning and 1 o'clock in the afternoon. After using Rocket Ninja to cope with 'B's' diabetic management over one month of design testing, the family reported that the child eagerly checked her sugar level and reported her diabetic status constantly. The child informed me that the most intriguing section within the game was that it allowed her to create her virtual avatar and pet features. This motivated her to constantly report her diabetic condition and insulin balance levels so as to gain the tokens to increase her game abilities and get money to buy a character's outfit. She also recommended increasing rocket decoration options in the game's shop as she stated that it did not have enough for her to create the outcomes that she wanted in this game. I noticed that the feature that she mostly paid attention to was the mini-quiz game. Providing the mini quiz in the everyday coping regimen can encourage children to focus on the diabetic-coping activities. She also wanted to show off her creativity regarding rocket customisation and decorating space. To optimise the feeling of creativity, she commented that the game connected her to her social circle of diabetic child patients rather than playing and interacting with the game system. In terms of character design within the game world, she gave her opinion that some characters represented too manly an appearance and the game had a lack of girl-friendly options. In general, the family reported that they were happy with the result of using this game to change the pattern of diabetic management and that the game had reduced their anxiety about their child's boredom in doing the repetitive activity of diabetes management in her daily life. They also emphasised that it would be great if there was a function to connect their child with other diabetic child patients in order to consult with them in the virtual world on coping-management issues.
Pros: 1.) Using Rocket Ninja can effectively promote the diabetic child's diabetes management in their daily life. 2.) The most visited feature within the game was the mini-quiz challenge. 3.) Providing daily surprises in the game's features led the diabetic player to report her daily data and constantly administrate her insulin intakes in everyday life. 4.) The game's visual language is appropriate for a child of this age.
Cons: 1.) Lack of options for girls to customise the game's features, for instance, decorations, virtual avatar, and pets. 2.) The final game seemed to constrain their creativity by lacking creative options with in the customisation mode. 3.) The child recommended validating the feature of social interaction within the game in order to connect the player with other diabetic child patients in Thailand.

Table 7.7 Participant B's feedback on Rocket Ninja noted by the researcher in this procedure (Klangpremjit, V., 2019)

215

Participant C

'C' lives in the central area of Bangkok and comes from a high-income family. He is the only participant using an insulin pump to help him administrate his insulin intakes and check the balance of sugar levels. In Thailand, the use of insulin pumps costs the patient a minimum of 200,000 THB (approximately GBP 7,000), which is a high expense. Paying for this expensive diabetic medical equipment shows that the family can afford any invention that might improve their child's management of his condition. His use of the game showed that he played the game quite often, 24 days over a month of game using. The missing date of reporting was because he left his mobile phone at home on a school day.

Regarding game-design function, the child reported that the game was attractive to him as it reminded him of the popular games Pokémon and Cookie Run through the visual appearance and the game's story. The favourite part of the game was customising and training the avatar pet in order to be able to beat the enemies down in the game's tasks. This means that the virtual pets feature was marked as the most effective trigger in the final game for him, urging him to continue playing the game. In this case, he did not report his condition constantly because he argued that the rewards gained from this game's feature were too low compared to repeating the mini-quiz game to gain the tokens. His caregivers were also concerned about this issue. They mentioned that the child cheated to report his daily data and manage his condition regularly by playing the mini quiz several times to achieve the expected points in the game.

From the parents' perspective, it would be great if the game embedded a diabetic Thai patient community in the game system, which would allow them to contact other patients. Providing the player with multi online modes can encourage the child to play more often. This mode promotes the player's feeling of prodding themselves and reduces the feeling of being separated from the surrounding environment in school. The parents also informed that the child had learnt relevant nutrition, coping with unbalanced sugar levels and insulin intake procedures from the game instruction model via the mini-quiz challenge. He was attracted by the graphics and his parents confirmed that he understood all the graphical language designed in the game. However, some signs and images were not related to the Thai context such as food icons and insulin intake procedure images. The parents reported that some of the food icons did not relate to their real-life situation — for instance, cheese, avocado, and spaghetti. They also highlighted that this would be suitable for the child to interpret, if the game delivered the Thai child with appropriate food options with visual language.

Moreover, the child played the final game quite fluently. He played the game without thinking or struggling. I discovered that some sections were not responsive in terms of game's production because he kept pressing the touch-on icon on the screen to select that feature. From the observation data, it seemed the participant was playing the game mainly for its entertainment value rather than to cope with diabetes.

Pros:
1.) The child was engaged with the game's mechanics including the storyline, the game triggers, player's flow stage of the emotions, and graphic appeal.
2.) The child rapidly learnt coping strategies with type-1 diabetes based on his mini-quiz performance.
3.) The family presented that this game had helped their child to organise his diabetic-management activities, and had also reduced their anxiety.

> **Cons:**
> 1.) The game did not offer the player with well-balanced economics. From testing feedback observation, the child kept repeating playing the mini game tasks rather than gaining scores based on his performance of the coping regimen.
> 2.) The game did not deliver a real diabetic social circle, allowing him to interact in the virtual world in Thailand within the game world.

Table 7.8 *Participant C's feedback on Rocket Ninja noted by the researcher in this procedure (Klangpremjit, V., 2019)*

Participant D

'D' is a six-year-old child living in suburban Bangkok. Her mother is unemployed and takes care of 'D's' condition by herself. Even though she is six years old, 'D' has just started school this academic year (2018). She and her mother found the first year of school life hard. Her mother mentioned that in the first year of being at school, she planned to cope with her daughter's diabetic-coping activities by herself rather than relying on school staff. The reason that she did not trust the school staff is because there is no evidence that the staff have the ability to tackle diabetic risk circumstances that might occur during the school day. Moreover, she informed that she is supposed to teach her daughter to cope with her diabetic-coping activities by herself before she starts primary school at age 7. From testing the final game experience, she told me that this game has helped her to release her worries about her child regarding school issues and also informed that 'D' had made progress in learning food-intake information and dealing with unbalanced sugar levels.

The child revealed that the parts of the game that she paid attention to were virtual pets pampering and the mini game. She liked that the feature allowed her to gain tokens that then allowed her to buy more stuff within the game's shop. Moreover, her mother reported that the most effective game trigger was the mystery box, as she had seen her child keep asking if it was about time for the mystery box to pop up. She also advised moving the mystery box's appearing time to the end of the day rather than having it present randomly in the gameplaying stage. Appearing at the end of the day would encourage the child to frequently report her diabetic daily status. In addition, the item that appears inside the mystery box should have a relevant meaning for coping with diabetic conditions in daily life.

The report shows that 'D' played this game 28 days over one month. In this case, the participant downloaded this demo game into her mobile phone and brought it along with her to school each day. The child was permitted to play the game in the time marked as insulin-intake time. Her mother informed that sometimes her teacher helped her to record the daily diabetic result into the game's feature. From the observation data, 'D' seemed to struggle with decorating her rocket and playing with her avatar. It appeared she could not play with these features appropriately. This was different from the fluent way in which she played with the mini-quiz mode. I also asked her which task in the quiz game she appreciated the most. She answered that the nutrition mode and food-intake instruction visualised in the form of a simplified icon engaged her.

Another issue advised by this family was that the child sometimes could not find the most appropriate stickers and icons to represent her emotions and status. For example, there is no icon to state the emotion of being neither good nor bad. As a consequence, the child sometimes used a different emoticon to identify this so-so feeling by choosing the angry face icon, which confused her parents as they thought the child was not happy with her condition that day. Providing more options of emoticon design were marked as an important issue by the child participant and her mother.

Pros:
1.) The child enjoyed the final game's mechanics including story game content, character design, game's aesthetic, and responsive game's interaction.
2.) The child had the positive outcome of learning coping with type-1 diabetes in the early stages.
3.) The game reduced the parent's anxiety regarding the child's boredom in coping with her diabetic condition.

Cons:

1.) The function of mystery box should appear at the end of the day because this would persuade the child to report her daily status.

2.) The game's economy was not well balanced.

3.) There were too few emoticons and stickers provided to the child for her to represent her exact feelings.

Table 7.9 Participant C's feedback on Rocket Ninja noted by the researcher in this procedure (Klangpremjit, V., 2019)

Participant E

'E' is six years old living in the suburban area of Bangkok with his mother and father. This case is the only case where the teacher was in charge of helping him cope with his diabetic regime during school time. In this case, the child already knew how to inject insulin into his body and how to tackle the consequences when his sugar levels were not well balanced. He informed that he strictly learnt this discipline from his doctor when he was newly diagnosed as having type-1 diabetes. The diabetic lesson was given by a specialist four days a week for four months alongside his mother at the Bangkok Children's Hospital before he started school.

In the aspect of gameplaying, he informed us that the mini-quiz games were too easy for him. The most useful one was the mini-quiz teaching on appropriate food intakes, but it was too easy to do this task. In spite of this, the child still thought that there were some parts of this session that were hard to interpret and were not relevant to his real-life situation. For example, this game mode offered him a Western food recipe icon involving cheese, salmon, and celery. The child's parents also said that the icons within this mode were beautifully designed but not practical in real life. To solve this problem, they suggested that the game should illustrate recipes the child is familiar with and ingredients that can easily be found in Thai markets. Suggesting well-known food for the child at this age can promote the ability to make appropriate food choices as they can take part in the decisions on food choice. Moreover, the child was interested in the game's design mechanics, which was noticed through his frequent use of this game to manipulate the diabetic-coping activities in his daily life. He downloaded the game into his mobile device, which he was allowed to use while at school. He also suggested that the game should maintain the feature of social interaction in which players are able to contact one another within the game world to exchange information about the diabetic-coping experience. Based on this notion, the existence of a social interaction mode could enhance feelings of being part of a tribe. However, the game was too easy for him. More should be provided. For instance, the monster in each planet was too easy to be beaten and the game's various levels lacked challenging tasks. The player had to wait till it was time for insulin-checking activities to be able to gain scores. As well, too few game levels were delivered in this demo game.

The most appreciated feature of this game for him was the 'my diary' mode, which allowed him to report his daily diabetes status. His parents also said that since they allowed him to be in charge of coping with his diabetic condition by himself, his reporting of his sugar level status had reduced their anxiety when the child was at school. The child emphasised that he used the 'my diary' mode to note down the things that he wanted to mark as important for coping activities in his school day. For instance, when he had a field trip at school, he needed to memorise what he had to prepare the day before and note down the expiration dates of insulin. His parents recommended that in this mode of taking and updating patient status, the feature should connect them online to keep track of his updated diabetic status. In addition, there were too few customising tool options to allow players to create their own creative outcomes such as style of typography, layout design, emotion icons, and decoration stickers. It was imperative to create an online shop for decorations for the 'my diary' book design to encourage players to engage with reporting their diabetic status and to upload their experience online to share with diabetic friends.

Pros:

1.) The game encourages him to constantly report his condition in everyday life through the 'my diary' mode.

2.) The game's visuals were well designed to attract him to the game's world.

Table 7.10 Participant E's feedback on Rocket Ninja noted by the researcher in this procedure (Klangpremjit, V., 2019)

Test design feedback summary

The significant responses and feedback of participating children were synthesised and reported briefly in the previous section. In this part, the findings are captured from the playtesting data in the form of game-design principles based on design elements through the technique of qualitative content analysis. Hence, significant feedback was categorised into each of the game-system elements ,which have been mentioned in this study: game's mechanics, interaction activities, aesthetics, and culture. The summary of players' feedback was divided into two strands. The first strand focused on the answers to a set of questions outlined in Table 7.11 regarding game-design elements (aim of testing design activities based on game-design elements). The second strand focused on summarising significant data to represent the players' feedback based on the objective of diabetic-coping strategies and experience through three modes of facilitating diabetic management: (1) instructional mode; (2) insulin-administration mode; and (3) organising self-data mode. The details of each strand of players' feedback will be discussed in the next section.

Players' feedback on game-design elements

To define the design principles of game elements, it has to be clarified how each element of the game responds to and interacts with the child player through the final test design activity. Participants were asked sets of questions during the fieldwork after they had played with the rocket game. The data below show the players' responses to each question in the form of a table comparing each participant's feedback. The table illustrates a checklist to show that each point has met the player's requirements in each standpoint of the game system. The checklist represents the successful elements that can persuade the player in each question of the game-design elements and also indicates which points need to be amended in the future.

221

Summary of players' feedback on game's design elements					
Questions	**A**	**B**	**C**	**D**	**E**
1.) Game's mechanics - Is the final game's story attractive to the child player straightaway? - Is the technique of non-linear narrative engaging to the child player? - Do the characters in the game represent players' selves in the game's universe? - Does the flow state of the player's emotions engage the player? What are their recommendations in this prospect? - Is the flow sequence of the final game placed in appropriate order for the player so that it does not lead to player confusion?	Y Y Y Y Y	Y Y Y Y Y	Y Y Y N Y	Y Y Y Y Y	Y Y Y Y Y
2.) Interaction activities - Does the final game provide players with responsive feedback? - Is the type of on-screen selection suitable for children aged five to six? - Is the game offered of proper size and suitable glare for the player? - Is the design of the game's reflex well interpreted for child players?	Y Y Y Y	Y Y Y Y	Y Y Y Y	N Y N Y	Y Y N Y
3.) Game's aesthetic - Is the game's visual aesthetic appealing to players? - Are the child players engaged with the game world's aesthetic? - Is the character design within the game attractive to players straightaway? - Is the final game's mood and tone suitable for children at this age from their parents' perspective?	Y Y Y Y	Y Y Y Y	Y Y Y Y	Y Y Y Y	Y Y Y N
4.) Culture context - Is the game's content appealing to the child player? - Is the game appropriate from the parents' perspective? - Are players playing without any hesitation? - Is the game's content appropriate for the Thai context?	Y Y Y Y	Y Y Y Y	Y Y Y Y	Y Y Y Y	Y Y Y Y

Table 7.11 Summary of players' feedback on final test design prototype (Klangpremjit, V., 2019)

The players' feedback on coping with type-1 diabetic features

This section determines the player responses to the diabetic-coping management features within Rocket Ninja. The list identified in the table below shows questions designed to gain each player's response to the diabetic-coping function. Firstly, in the instructional mode, this function was designed to divide the data of diabetic-coping conditions into three main sections, which are: appropriate food intakes, understanding the balancing of sugar and insulin levels, and dealing with unbalanced insulin levels. All of these three subsections of diabetic information were interlaced into the game's designed elements constructed in the rocket game prototype in the form of triggers and strategies such as a mini-quiz challenge, virtual pet pampering, and collecting rewards. The player earned scores based on their answers in the quiz game and the scores could

be used to buy equipment, weapons, and decorations in the game's shop. Secondly, in the insulin-administration mode, the players were alerted every time insulin intakes and checking of sugar levels were required in their daily life. In this part, the players gained tokens based on their insulin-level results and properly reported their results into the game system via the function of 'my diary'. Thirdly, in the organising diabetic data mode ('my diary' mode), this feature permitted the players to organise their diabetic data and report their status every day in the form of memos. The frequency of uploading their status into the game's system would be turned into scores and rewards for them within the game's world. Lastly, there was the cooperation feature between the diabetic child player and caregivers in the form of interaction and feedback via the game's system, such as organising mode of data, and evaluating the result of each stage level for the diabetic child. From the diabetic functions that have been stated above, the table below outlines the questions asked of the participants regarding the diabetic-coping functions.

Objectives of testing design activities based on diabetic-coping function	
Instructional mode	- Are the game's graphical language, signs, and icons easily interpreted? - Are the diabetic-coping strategies appropriate for children of this age? - Are the levels of complexity too hard for the child to interpret? - Which part of the diabetic information was the most useful to them? - Are the game's rewards from this feature well balanced compared to other tasks? - Has the diabetic child progressed in learning to cope with type-1 diabetes?
Insulin-administration mode	- Is the graphical language within this feature easily interpreted? - Is it too hard for the child player to report their insulin and sugar levels using this feature? - Is it responsive to the player? - Are the game's rewards from this feature well balanced compared to other tasks?
Organising data	- Is the graphical language within this feature easily interpreted? - Are there enough options for them to customise their organiser book for the daily diabetic data? - Are there enough functions to help the diabetic child take daily notes? - Is the interaction menu in this mode easy to operate, specifically for this targeted age group (5–6 years old) - Is the layout design pleasing to the diabetic child? - Do these features restrict their imagination? - Which function in this mode was the most useful for them? - Is this mode easy to use? - Has the child made any progress in manipulating diabetic data regarding their diabetic status in daily life? - Which part of this mode needs to be amended?
Cooperation between stakeholders	- Are the game's graphical language, signs and icons easily interpreted? - Is this feature easy for caregivers and diabetic children to use? - Can the diabetic child interpret the feedback from caregivers?

Table 7.12 Objectives on testing design activities determined in the early stage through the perspective of the diabetic-coping function within the final game (Klangpremjit, V., 2019)

Once the set of questions regarded coping strategies had been clarified in this stage by the response feedback from these diabetic participants, the researcher compared each participant's feedback (as shown in Table 7.12). The key understanding of this section represents the diabetic participants' feedback that validated the serious game's design discipline, allowing the final principles of serious game-design to be defined in this study. As a consequence, the data relying on the diabetic-coping activities perspective on game design allows us to immediately highlight what needs to be amended and maintained in this game's features for further research.

Summary of players' feedback on diabetic-coping features					
Questions	**A**	**B**	**C**	**D**	**E**
1.) Instructional mode					
- Are the game's graphical language, signs, and icons easily interpreted?	Y	Y	Y	Y	Y
- Are the diabetic-coping strategies appropriate for children of this age?	Y	Y	Y	Y	Y
- Are the levels of complexity too hard for the child to interpret?	Y	Y	Y	Y	Y
- Which part of the diabetic information was the most useful data to them?	Y	Y	Y	Y	Y
- Are the game's rewards from this feature well balanced compared to other tasks?	Y	Y	Y	Y	Y
- Has the diabetic child progressed in learning to cope with type-1 diabetes?	Y	Y	Y	Y	Y
2.) Interaction activities					
- Is the graphical language within this feature easily interpreted?					
- Is it too hard for the child player to report their insulin and sugar levels into this feature?	Y	Y	Y	N	Y
	Y	Y	Y	Y	Y
- Is it responsive to the player?					
- Are the game's rewards from this feature well balanced compared to other tasks?	Y	Y	Y	N	N
	Y	Y	Y	Y	Y
3.) Game's aesthetic					
- Are there enough options providing them to customise their organiser book for the daily diabetic data?	Y	Y	Y	Y	Y
- Are there enough functions to help the diabetic child take daily notes?	Y	Y	Y	Y	Y
	Y	Y	Y	Y	Y
- Is the interaction menu in this mode easy for them to operate, specifically for this targeted age (5–6 years old)?	Y	Y	Y	Y	Y
- Is the layout design pleasing to the diabetic child?	Y	Y	Y	Y	Y
- Do these features restrict their imagination?					
- Which function in this mode was the most useful for them?	Y	Y	Y	Y	Y
- Is this mode easy to use?	Y	Y	Y	Y	Y
- Has the child made any progress manipulating diabetic data regarding their diabetic status in their daily life?	Y	Y	Y	Y	Y
	Y	Y	Y	Y	Y
- Which part of this mode needs to be amended?					
	Y	Y	Y	Y	Y
	Y	Y	Y	Y	Y
4.) Culture context					
- Are the game's graphical language, signs, and icons easily interpreted?	Y	Y	Y	Y	Y
- Is this feature easy to use by the caregivers and diabetic child?	Y	Y	Y	Y	Y
- Can the diabetic child interpret the feedback from caregivers?	Y	Y	Y	Y	Y

Table 7.13 Summary of players' feedback on final test design prototype regarding the diabetic-coping features in the final game (Klangpremjit, V., 2019)

After understanding the players' feedback on the final design test stage, all of the insights gained from every stage of the design procedure will be concluded in the next section.

Summarising the design principles based on iteration design of playtesting feedback

In this section, the initial design players' responses and the final game-design feedback are synthesised. To formulate the design principles that are easily interpretable by the readers, the study categorised the insights of players' feedback on game prototypes into the strands of serious game-design standpoints, i.e.: (1) designing game elements and (2) defining the features of coping with diabetic strategies and management. Based on these two standpoints, the notion of distinguishing this objective of serious game design can be harnessed into game-design thinking for future research in similar areas of game practice.

First, the section of diabetic serious game-design elements was concluded through knowledge of contextual studies on game-design disciplines and activity of design research. The understanding of players' responses on the initial game helped to formulate and evaluate the final game-design criteria demonstrated in the early part of this chapter. In this part, the knowledge of persuasive factors of serious game-design elements gained from the research activities conducted in this study from the beginning stage to this stage will be summarised. Secondly, the part of designing the diabetic-coping feature within the game system was validated by the data on semi-structured interviews of playtesting with 10 diabetic participants and 5 diabetic patients (first and second stages, or including parents) in the final playtesting stage. This strand focused on the diabetic experience requirements – those that were anticipated to be contained in the diabetic game. Then the players' feedback on the final prototype was used to reconsider what game features needed to be maintained or amended based on players' and caregivers' feedback. Before the project separates and categorises each item of feedback on the game's design elements, it is imperative to mention the comprehension of players' feedback regarding this issue in the form of a design conclusion summary. The data was revised several times through the interview transcripts, photos, and videos. The overall response was designed to please the child diabetic participants. The intriguing significant data from the participants in this stage was taken into consideration for the design criteria proposed to persuade the diabetic child to engage with the model to bring about behavioural change through the game system.

To conclude, the participating type-1 diabetic children (N=5) were satisfied with the overall final game's elements and its content constructed within the final design.

However, there are some parts of the game that still need to be amended, which are: (1) some functions in the game did not interact with the player; (2) some of the recipe and food-intake icons in the mini-game quiz did not match the child's real-life food choices; (3) the game's economy has to re-balanced in some parts; and (4) there are too few customising options to validate their feelings and show creativity and virtual status.

Besides, the section on diabetic-coping features within the game was mainly discussed through the diabetic child participants' feedback regarding the progress of evaluation between, before, and after using the game to promote the diabetic-coping experience. The parts that need to be amended that were reported by the diabetic participants on the final test activity were:

1) the tokens gained from each diabetic feature were not well balanced;
2) the diabetic information was too easy for the child;
3) there was a lack of options to customise the diabetic notes and show their feelings in the 'my diary' mode; and
4) suggestions of players and stakeholders promoted real interaction between stakeholders in the online world.

The two tables above, which mentioned the players' response and feedback in the two areas of diabetic serious game components – game-design elements and diabetic-coping strategies have demonstrated the elements and sections that were not satisfactory to the player. To be easy for the reader to interpret, the study illustrated the data that emerged from the playtesting activities in the form of two diagrams divided into two prospects on gameplaying based on caregivers' views and diabetic children's views. The first set of diagrams represent negative feedback from diabetic players and caregivers, while the second set of diagrams shows positive feedback.

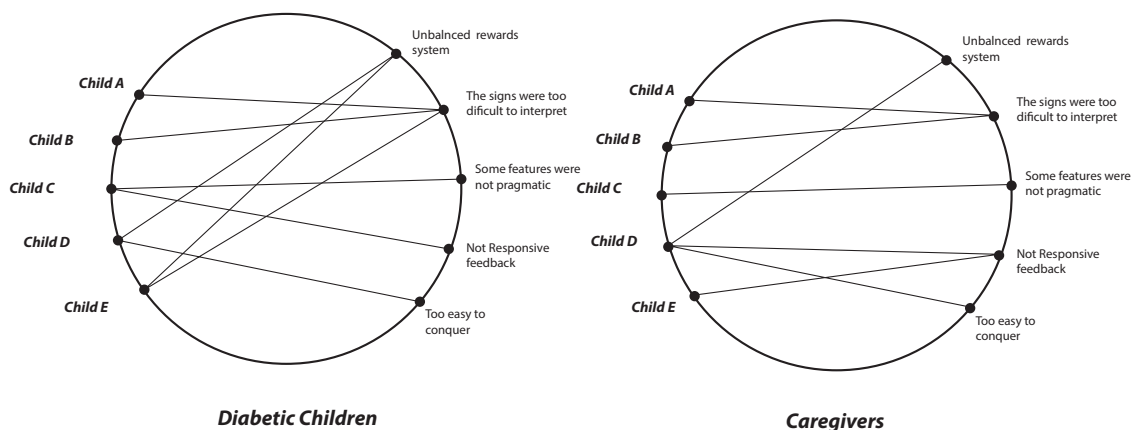**Figure 7.26** *Negative feedback of stakeholders on rocket game prototype (Klangpremjit, V., 2019)*
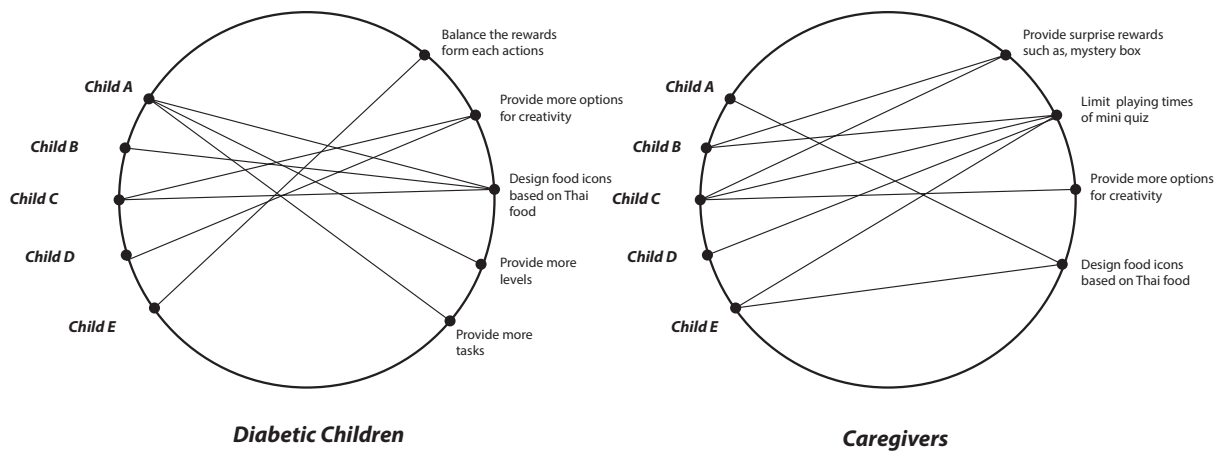
227

Figure 7.27 Suggestions of stakeholders on rocket game prototype (Klangpremjit, V., 2019)

These figures demonstrate the overall data from diabetic child player participants through the method of case study analysis. The insights gained throughout this procedure will be summarised in the form of a table, as shown below.

Summarising design disciplines for diabetic game-design elements relying on design process	
1.) Requirement to define the game storyline	- Stating the importance of being part of a tribe - Being familiar for the children at this age, yet offering the sense of an imaginary world - Reducing feelings of guilt by creating the storyline based on child educational content - Offering non-violent content - Having the potential to enhance a child's creativity.
2.) Designing the diabetic game's characters	- Striking a balance between childish appeal and mature game appearance - Representing evaluation stages of player's avatar - Offering a hint of Asian aesthetic, representing the sense of cuteness influenced by Japanese child media - Providing features that allow the player to freely customise their virtual avatar.
3.) Defining the mood and tone of the game sphere	- Balancing childlike styling of game's graphical appearance and mimicking adult game visuals - Offering the immersive experience of a fantasy world.
4.) Defining the flow state of the player's emotions	- Maintaining the five stages of behavioural change mentioned repetitively in this study - In each stage of patient behavioural change, the flow stage of player emotion has to be embedded in the game's structure, which are: (1) feeling of exploration; (2) feeling of accomplishment; (3) feeling of curiosity; (4) feeling of belonging, and (5) sense of competition. - Providing a surprise consequence to the child players for every coping activity to encourage players to constantly take care of themselves - Preserving game triggers in order to engage the player throughout the game's lifespan.
5.) Defining sequence of game's flow	- Simplifying the sequence of game flow and wellness frame to be easy for the player to interpret - Placing the player's outcomes within the game on the first main page, based on the nature of simulation games - Positing the game's features menu in the corner of the main page in the form of icons - Stating the storyteller at the beginning stage of gameplaying.
6.) Mode of interaction activities	- Using the click-and-release technique to make selections on the screen - Providing large-sized icons and symbols in the game - Reducing text while promoting visual signs and icons.

Table 7.14 Section 1:Summarising the design disciplines for diabetic game elements relying on design process (Klangpremjit, V., 2019)

Summarising design disciplines for diabetic game-design elements relying on diabetic-coping features	
1.) Instructional for coping with type-1 diabetic condition	- The information should be practical for the early-age diabetic child — for instance, contact number of diabetic child's hospital, appropriate food choice that is easily found in Thailand, and school-related information. - The visual language should be simplified in the form of commonly interpreted symbols. - The game has to limit playing repetition in the mini-quiz challenge to gain scores, in order to encourage the player to accomplish another task within the game such as organising data mode. - The game should promote differences in complexity for players to choose.
2.) Insulin-administration mode	- The information in this feature representing the insulin intakes and sugar-balance checking procedures should be narrated through visual instruction. - The administration process should be designed with signs and illustrations that are easy to interpret. - This game's mode should provide and upload the sugar-level status directly online to the 'my diary' mode.
3.) Organising data	- This part was highlighted by the diabetic players as a useful feature for them to adapt to their school-day life. - The feature should deliver effective options of noting, which support players to engage with and upload their diabetic status to the social platform. Three options were recommended by stakeholders: (1) stickers to express patients' emotions; (2) decoration options for customisation tool such as notebook decoration; and (3) reaction on coping with the diabetic performance of caregivers. - Every time a player uploads diabetic data, the player is supposed to gain higher rewards compared to rewards gained from other features, based on interviewed data.
4.) Defining the flow state of player's emotions	- This feature was suggested to transform the caregiver's feedback data on child's coping performance into the form of images, icons, and signs. - The comments from caregivers suggest that the game should contain scores for their child relying on the frequency of the child's data report. - Caregivers expect to see the summary report of the diabetic child in the form of a visual.

Table 7.15 *Section 2: Summarising design disciplines for diabetic game-design elements relying on diabetic-coping features (Klangpremjit, V., 2019)*

7.4 Conclusions

In this chapter, the process of game design undertaken in this study to determine persuasive diabetic game-design disciplines was divided into three subsections of empirical research –namely, fieldwork, initial design playtesting, and final design playtesting. The fieldwork data helped to define the users' requirements regarding diabetic-coping experiences and the meaningful digital gameplaying demonstrated persuasive triggers within the game for this project. This allowed for the identification of the design criteria for the first game prototype, Garden Tower. Initial design playtesting data was used to validate the insights of design criteria gained from the previous research step. To comprehend the diabetic players' and caregivers' responses on playing the initial game (Garden Tower), qualitative content analysis was applied in this section through three methods: (1) semi-structured interviews with 10 diabetic children; (2) observation; and (3) a focus group testing activity with 20 non-diabetic children aged five–six years. The insights gained from the initial mock-up test design provided an understanding of the parts that needed to be evaluated within the game system. Once the feedback of stakeholders from this process had been analysed, this knowledge provided a definition of a set of design criteria for the final game.

In the last stage, Rocket Ninja was designed based on data harvested from the previous research stage (fieldwork research and initial playtesting data). The final game-design prototype was tested to validate the design principles and ascertain the design discipline from previous knowledge gained from research. The playtesting activity of the final design was conducted in Thailand in 2018, by interview and one-day observations with five diabetic children. The fieldwork aimed to understand players' response to using the game over one month to enhance their coping with type-1 diabetes in their daily life. After testing the rocket game via the android phone provided by me to three of the participants (2 of the participants owned devices), 5 diabetic children were interviewed and observed over one day. This procedure was designed to find out if the rocket game could serve them with a meaningful play experience as well as promote diabetic management with the cooperation feature. Content analysis was applied at this stage so as to analyse the stakeholders' response on gameplaying to finalise the diabetic game-design principles in this study.

The project demonstrated that the serious game persuasive design disciplines for Thai diabetic children aged five to six years relied on these three steps of game design. In the next chapter, the overall research findings that emerged from each stage of the research procedures in this study will be discussed and summarised.

Chapter 8: Discussion and Conclusions

Reflections on every phase of the research findings

This chapter is focussed on the critical outcomes, insights and new knowledge contribution from the game design process and user testing of the game *Rocket Ninja*. It will discuss the main contributions to game design research, the conclusions garnered from the research and the field research, what was learned, and would be done differently if it were conducted again with the knowledge gleaned from the process. It will also discuss how future researchers might build on this work and where this game design research might impact other serious game design and the industry as a whole. It will also mention where this research can take me in the next steps of my own design career after the conclusion of this research.

The contribution of new knowledge is discussed in three main sections, which include: discussion, conclusions from this research process, and suggestions for further research.

- Discussion: this section provides reflections on the responses to the research questions, including findings related to the aims and objectives of the research.

- Contribution to new knowledge: this section provides an overview of the knowledge gained from the research, the insights from the field research and user testing, and what was learned from the process, as well as what would be done differently if it were conducted again with the current knowledge of the process.

- Suggestions for further research: this section focuses on how the research findings could be expanded by conducting post-doctoral research in health game design by myself or by others, in order to help other game designers gain deeper insights into the area of practice of Serious Game Design practice-based research.

8.1 Discussion

This section consists of two main subsections: (1) a discussion on responses to research questions; and (2) the contribution to knowledge.

8.1.1 Discussion of the research questions (Contribution to games design research)

To respond to current problems for diabetic children aged between five and six in Thailand, this research explored specific diabetic patient requirements, by using a qualitative case study research method discussed in Chapter 4. Based on the case study

research, insights were gained into the users' demands and expectations for the features of a game. The patients' requirements identified in the user fieldwork (discussed in Chapter 5)were categorised into eight main points: (1) no school support; (2) lack of age-appropriate learning resources; (3) difficulty in applying the knowledge of coping strategies in reality; (4) lack of motivation; (5) lack of trust between home caregivers and school staff; (6) frustrations with coping activities; (7) feeling separated from society; and (8) dealing with data difficulties. Accordingly, the barriers to coping with type-1 diabetes were addressed to a greater extent than the existing research studies (Makhlysheva, 2013; Royer III, 2017; Chongsawat et al., 2016; Stone, 2013; Lieberman, 1988; Chaseman, 2016; NiLufar et al, 2016)., which mainly determined the barriers to coping with this condition from the perspective of motivation and managing self-data.

Addressing these themes from users, it has been shown that diabetic children and their caregivers' requirements can be synthesised into four main features of diabetes health games, which were; (1) instructional mode - the mode in which deliberately designs for instructing on the coping strategies for young children; (2) insulin administration mode - the feature which was targeted to provoke the child to continually manage and balance their sugar levels; (3) self-data mode - the mode that targets how the diabetic child will record and learn from their daily data, with regards to sugar levels and food intake, which aimed to reduce the caregiver's anxiety during the child's school day; and lastly (4) gaming mode - the mode that focuses on the playing experience, which aimed to promote the child's frequency in paying attention to how they spend their time, with three modes mentioned in chapter 6 (p.177).

In relation to the factors of meaningful game play experience, based on these findings, the meaningful, persuasive gamified experience, as well as the diabetic child and their caregivers' needs, can be classified using categories drawn from the domain of games design elements. To clarify, the research discussed herein encapsulates the development of new understandings of serious games research and development, through these four sub-categories that purposed to respond to the diabetes games' objectives, which are; (1) appeal, (2) understanding, (3) usability and, (4) player experience. 'Appeal' refers to the ways in which the game focuses on the visual representations and how its mechanisms can engage a young child. While, 'understanding' focuses on how a child player can decipher the diabetes game's information and their ability to understand this information, with regards to the coping strategies of type-1 diabetes. The usability concerns are how child players operate the game system and use it as part of their daily routine. Lastly, 'player experience' refers to the way in which the game designer

understands game play experiences for the targeted players. The diagram below visualises the hierarchy of the game design principles summarised through this thesis.
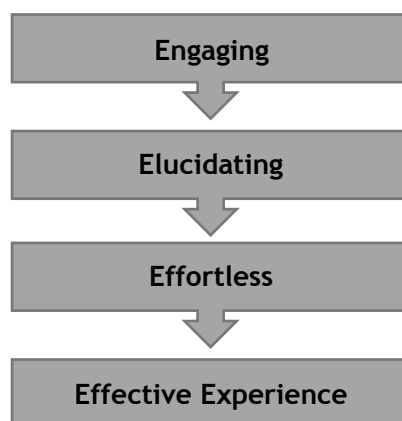

Figure 8.1 *'3E' principle (Klangpremjit, V., 2019)*

To achieve the aims of this research, the concepts for the effectiveness of diabetes games design principles are encapsulates here, driven by the fieldwork data and the design process undertaken. To produce the productive play experience through the intervention of serious games, this study suggested the '3E' principle, which includes 'Engaging', 'Elucidating', and 'Effortless'. In the following sections, each cluster is discussed as can be seen in the image 8.1 above.

'ENGAGING'

The first cluster, 'Engaging', focuses on the motivation behind playing digital games for young children, to develop the persuasive triggers that tend to be embedded in the serious games elements. Initially, it was argued that the role of cultural identities influenced the child player's digital games perception and game-playing ability. It is imperative to highlight that the three clusters of player motivations are driven by the role of cultural identity. To be more specific, the details of each cluster were synthesised from significant data gleaned from the specific participants' information regarding their real-life situations. In spite of the fact that the core motivational drives of the players are shaped by social identities, the results here uncovered some similarities with the existing research on diabetes games. For instance, the participating children frequently mentioned the sense of accomplishment and escapism, which is similar to the previous research findings (e.g. Steiner et al., 2000; LeBlanc, 2000; Michael et al., 2013; Chou, 2014).

Based on this argument, this led to the exploration of the attitudes of specific players' to identify their requirements, regarding the productive games triggers through qualitative research methods. The research led to surmised insights that to appeal to the targeted players, diabetes health games should be designed through the lens of three clusters: 1) prosocial game-playing behaviour; 2) the notion of escapism; and 3) the sense of accomplishment. Relying on these three clusters, the project discovered that the main motivations laid down appeared to extend those demonstrated by LeBlanc (2000), Ryan and Deci (2000), and Michael et al. (2013). In fact, the previous research that explored players' motivational triggers revealed a specific set through a psychological perspective, by providing certain key themes, which are: achievement, social impacts, scarcity, accomplishments, showing creativity, rewards system, and sense of competition.

The results from the play-testing from this research with two prototypes, suggested that children at the ages of five and six years were engaged in the triggers that presented them with signs of prosocial behaviour within the games' sphere. The feeling of prosocial playing behaviour can be amplified through both intrinsic and extrinsic values within the games' system. Through the aspect of intrinsic triggers, the findings revealed that the participating children were attracted to the cooperation features, which allowed them to play the games' task as a team supporter, rather that competitive activities and stand-alone achievable missions. Serious games designers can respond to this requirement by providing features that allow players to select an avatar's role based on their interest in being part of a tribe. In this study, there were four types of player role: supporter, leader, collector, and explorer. Furthermore, the feelings of being accepted by peers can be designed through the games' narrative structure, which emphasises the importance of taking responsibility in their own roles within games' storyline.

The concept of prosocial behaviours in playing digital games was not only delivered through cooperation tasks and missions within the games' sphere, but also driven by the caregivers' decisions when purchasing digital games content. This study exhibited appropriate games content that was based on the data from the interviews with the participating caregivers: being relevant to educational media; non-violent tone of visual representation; and using appropriate content for the child's age. In this study, developing games that are relevant to educational media was explored through the method of observation and interviewing. In the Thai social context, playing digital games is tantamount to being disobedient and having bad personal characteristics according to the fieldwork data. Based on this aspect, the children did not reveal their personal interest in playing digital games to the interviewer. In this study, the use of drawn evidence revealed that the participating children did actually engage in digital

games since their content was exhibited through the drawn images (Kress and Van Leeuwen, 1996). Designing the relevant tone of educational media can be used in designing games' narrative structure and content based on the empirical design activities undertaken. The term 'games' aesthetic' that was revealed through the results of this research demonstrated that designing a visual aesthetic that mimicked the educational media offered the children little visual appeal, as it reflected non-challenging and repetitive content compared with the other child media.

The next sub-category, the notion of escapism, was synthesised in this study as a set of games' triggers that can immerse the player in another world through three elements within games' system: games' storyline, games' aesthetic, and games' features. To provide young players with the sense of escape, the games' content should be narrated through the story. At this age, children found it difficult to have this sort of experience in their real world. The research also discovered that games' storylines that were too close to the images normally found in the school environment provided non-appealing triggers.

Taking this idea into consideration, the concept of escapism can be driven by both the intrinsic and extrinsic values. Regarding the term 'intrinsic values', games should motivate the players' feeling of belonging, showing their creativity and sense of exploration. Games designers can encourage players' feeling of belonging through the mode of creation within the games' world, for instance, building a city, creating a virtual avatar or pets, cooking, and dressing up. The mode of creation not only gives the players a sense of ownership, but also supports players' creativity. The study revealed that the players feel accomplished when they have shown their creativity outcomes through customised virtual belongings, such as decorated items, dressed-up avatars, and upgraded items. The results also revealed that if the games do not deliver a variety of options to players, they might feel that the game restricted their imagination, which leads to an unsatisfactory play experience. The sense of exploration can be developed through the function that allows the player to wander into the imaginary and fantasy world. In this sense, the research concluded that an immersive imaginary games world can be designed through the games' storyline that allows them to imitate the others' roles, which they cannot do in reality. This included playing adult roles, fighting content, cooking, and simulation situations games.

Through the extrinsic values related to the sense of escapism, the study illustrated that there were two themes that evoked this sense, which were the influence of the Japanese visual aesthetic in children's media, and imitating mature games' appeal. Based on the interview and observation data, Japanese children's media played a big role in Thai

children's media. This was also supported by the interviews, observation and drawing evidence data, which showed that almost all the participating children mentioned Japanese media that they had seen in the form of cartoons, comic books, and games. Taking into consideration Japanese children's media at the time this study was conducted, it was found that a similar visual and graphic tone was reflected through that media. Representations of signs of cuteness in the form of childish innocence through human figure distortion, such as big eyes and head and a graceful body, were repetitively visualised in this kind of media. From the findings, representation of this style of graphical language not only attracted the children in terms of the visual appeal, but also supported their sense of caring and reduced their violent feelings. However, the research discovered that if the games offered players an overtly childish visual aesthetic, the games would not maintain their interest. To tackle this problem, the games designer should balance the sense of childish visuals with mature games' appeal to engage players. Based on the results of playtesting activities, it can be seen that children at this early age tended to play the games which offered them challenging visuals, that imitated the mature games' visual aesthetic. An intriguing point that arose in this stage was that girls and boys manifested their interest in games' graphical language differently. The participating girls were mainly attracted by the childish visual represented through the form of cuteness, simply-shaped forms and innocent looks, those that amplified their caring sense, while the boys commented that this kind of visual representation was boring. According to the aim of this study, as the game was intended to be played widely by both genders, the designer combined the content and visual aesthetic that both genders were interested in.

Regarding the final sub-category, the sense of accomplishment, the study also illustrated the core ideas that aimed to formulate a set of productive triggers for this sense, which were categorised into two aspects: intrinsic and extrinsic values. To motivate the intrinsic values, the research summarised three main themes in the users' design section (chapter 5): showing the players' creative playing progress and outcomes; encouraging their sense of sharing; and providing a sense of caring. The extrinsic values can be formulated through three clusters: 1) rewards system; 2) representing themselves with their virtual character; and 3) exploring the games world or expanding the games levels and territories. The research also discovered that in each stage of game playing, players' expectation for each type of reward (both internal and external rewards) within the games was diverse. Almost all the participants revealed that in each level of game play, the games should provide them with a set of triggers that included the state of being a winner, achieving mastery, the feeling of ownership, and showing their game progression and creative outcomes within one stage of game playing. More importantly, in addition to providing the specific player with these determined triggers, the young

children expected to play the set of triggers that should be included in the stage of the gameplay. The study developed the rewards feedback loop system that was synthesised from the fieldwork data, which is discussed in section 8.2.4 (User testing of games design). It can be summarised that the result of this study identified a set of persuasive games triggers, which offered a new insight into how the games' mechanics appealed to young Thai players.

'ELUCIDATING'

This cluster mainly focuses on how easily the diabetes health games can be understood by children aged five or six years depending on their cognitive and physical development. The findings in this cluster were cultivated from play testing feedback on how the participating children respond to the games' prototypes. The study developed the idea of elucidating two main concepts: the child's ability to understand knowledge related to coping with type-1 diabetes; and the child's ability to perform the games' system on-screen. In the first strand, the study was mainly concerned with how the games designer can provide a set of information related to coping with diabetes, which is easy for young children to interpret. The second strand intended to formulate the design principles that deliver an easy games system for children to be performed through the screen-based play. Regarding these two strands, the research encapsulates the design insights in the following sections.

To make it easy to interpret, visualising the coping data into diagrams, icons and signs can promote learning abilities and provide an appealing graphical representation for children of these ages. It was revealed within the play testing feedback that the participating children skipped and clicked through the information pages rapidly. It was also found that some learning coping strategies can be conceptualised into gaming techniques such as a mini-quiz challenge, which was useful to be incorporated into learning about food choices and caring for avatar pets strategies, that aimed to teach the process of insulin monitoring. Based on the data from interviews with caregivers and the play testing responses, the children of these particular ages did not fully understand the way in which they adjust the amount of insulin dosages, as it was too complex for their learning capabilities. This research suggests that for child players of these ages, when they are newly diagnosed as type-1 diabetic patients, the games should restrict the coping information to sugar level monitoring. Moreover, using a metaphor to provide a diabetic child with coping information was found to be a more effective tool than teaching them directly through the tone of educational medical media. The participating children responded to the metaphor technique, as it was less worrying than the method of educational visual representation in terms of anxiety reduction.

Furthermore, it was concluded that there are two ways of teaching coping strategies through serious games intervention: passive and active activities. Passive activities are the way in which the diabetic players learn to cope with their condition by reading and listening, while active activities are the way in which diabetic players can learn through their game-playing performance. Through passive activities, diabetic health games should provide the information to the child player by converting text information into images. Research found that participating children did not respond to the pages that represented this kind of information (i.e. examples of blood sugar monitoring and the storyline that was narrated through the book illustration technique). Moreover, maximising all the information that tends to teach coping activities should be designed through the mini tasks and quests within the games system. This means that all the learning to cope information should be included as active activities in the games systems. At the end of this study, the participants also suggested applying new kinds of technologies that support active activities to learn coping strategies in a way which is more attractive and engaging, for instance, incorporating augmented reality into the learning about food choices in the supermarket to enhance the child's perception and adapting body sensors to promote learning about insulin injection activities.

Taking into consideration the strand of young children's capabilities to perform on-screen playing, the study encapsulated the ideas that aimed to enhance the type of game perception based on the play testing feedback. It was concluded that there are three aspects that the serious games designers should consider for this requirement: 1) games' flow; 2) capabilities of users to play on-screen; and 3) difficulties with accomplishing the games' tasks. With regard to designing games' flow, young children tended to explore games, which allow them to freely select the mode they prefer to play at any time. However, delivering non-sequences and a freely selected mode to play made the young children confused about the games' ordering. This study revealed that bringing up the main menu pages that contained features which allowed them to freely elect to play at the beginning of game play caused the participants to struggle with which feature they were supposed to play first and what to do next. Based on the findings, the participating children preferred to freely select the mode that they wanted to play even though they were not able to play the games in the appropriate order in which the games were designed. The project had determined that the simulation games were the most appropriate type of games to promote play experience and balance fun with the coping activities, offering the main menu page to show the progression of their playing outcomes, as the first page seemed to be a suitable technique according to all the diabetic participants. Diabetes games that are designed with spiral ordering might not work well with this type of simulation game. Moreover, delivering a tutorial mode that

animated the instruction and provides encouragement to the child player was emphasised as an essential method, especially for players of these ages.

In terms of performing on-screen selection, children of these ages tended to fully understand the simple form of making a selection on-screen, which was the click and release technique. The testing feedback revealed that 'drag and drop' and 'drag and release' selection were suitable in some types of selection, for instance, expanding scene, changing the games' camera angle, and scrolling on equipment options. Furthermore, offering an appropriate technique of making the selection on-screen was not sufficient to deliver responsive interaction for the young players. This research found that providing indications that demonstrate the results of their actions was essential. These can be divided into two types: visual effect and audio effect. Visual effect refers to the way in which games can respond to players' selection and actions through visual representations, while audio effect focuses on the way games can reflect responsive indications through sounds. The findings showed that to amplify their feeling of accomplishment, providing a perceptible signal helped the player to feel that the game is responsive.

'EFFORTLESS'

The last section demonstrated that meaningful play, as part of the diabetes games experience was 'effortless'. This study interpreted the term 'effortless' as the way in which young children find it easy to access the games within their daily life. To clarify this point, the thesis suggests that diabetes games should provide the young players and their caregivers with a convenient way to access coping features, for instance, insulin administration activity, self-data monitoring, and reporting daily data. The gaming features should be easy for the child to resume game playing. In the strand of coping activities through the games system, balancing the difficulties of learning to cope with type-1 diabetes was reported as a specific concern of the designer. The testing feedback in this study showed that diabetic children tended to play the mini-quiz challenges which were designed to instruct the child about appropriate food choices repetitively, when the games was too easy to win the tasks. Diabetes games have to restrict the frequency of playing on each day based on the coping activities, otherwise, the child will figure out a way to obtain games' rewards without being concerned about their diabetes. Moreover, offering main pages that represented their current stages of playing outcomes, such as showing their journeys and representing the decorated and built intervention, was responded to as it made it easy for them to interpret the games' process when the players had resumed the games.

Through the concept of self-data monitoring and reporting the daily results regarding food intake and insulin dosage to caregivers, the system has to include features, which encourage young children to monitor and report constantly. This study suggested that a rewards system based on caregivers' feedback can be used to promote the frequency of self-data monitoring and reporting. However, typing can lead to frustration with reporting data in children of these ages. Therefore, at the end of this research, the participants suggested that a set of various emoticons and stickers should be developed to cover all their data expressions through the mode of "my diary", instead of typing the details. For instance, designing a set of food ingredients stickers such as fish, carrots and milk might make it easier for them to record their food intake, rather than typing the name of ingredients. The feedback also reported that information related to food choices has to be relevant to the food in their real-life context. Based on the feedback that focused on the food intake instructional mode, the study emphasised that using the new technology to be applied to this learning technique was effective for the diabetic patients in this particular context as it will be easier for them to access the information, (through QR code or augmented reality). This can also be used to update the food intake data, which will be easy for games designers to link with food choices in their local context.

In the fieldwork data, it was reported that some caregivers of diabetic children had to go to their child's school to perform the sugar monitoring and insulin administration themselves rather than let the school staff do it. It was found that the notion of trust is a massive barrier between the caregivers and schools. This led to almost all the caregivers feeling anxious when their child was at school. In the Thai context, the notion of trust between caregivers and school staff was seen to be a significant problem in this study. The need for appropriate information for this specific patient age group was also highlighted in this study, since this issue has not been addressed in earlier studies such as those of Lieberman (1988), Makhlysheva (2013), Stone (2013), Clasemann (2016), and Nilufar et al. (2016). This study suggested that to reduce the caregivers' anxiety, maintaining a current diabetic child data report during the school day is essential for the games' system. Designing a system that constantly reports the diabetic child's data through an accessible system was noted as one of the design criteria for the diabetes games in this study. Furthermore, uploading the result of daily data into the mode of 'my diary' content allowed the child and caregivers or even school staff to interact and exchange their response in the form of rewards or knowledge instruction, or even positive encouragement. These kinds of interaction activities are relevant to the life-data results and can amplify feelings of trust, which leads to coping effectively with type-1 diabetes in future life.

To conclude, the meaningful game experience of digital games in the context herein was embodied in every one of the game's design elements. In terms of the game mechanics, the persuasive factors were focused on as a game system designed to support the design triggers to encourage the players to play a diabetes-related game. Part of the interaction activity was constructed with intriguing external design triggers in the form of audio interaction, visual interaction, and physical interaction. The term 'aesthetic' refers to an appealing graphic design that can enhance children's playing experience and encourage them to play the game, while the cultural context helps the game designer to refine what content could attract Thai children. Throughout the research, it could be seen that each of the games' elements have different roles to motivate young players based on the model which has been identified through this study.

8.1.2 User testing of the game design

To define the game's triggers, investigating problems related to coping with type-1 diabetes and the core motivations were placed at the first stage of the research. The game playing motives were interwoven into the model of behaviour change, which identified the player's motivations, the persuasive game's triggers, and the productive types of interaction. In the last stage of this research, the study finalised the design principles in terms of the type of rewards that could help the patient cope with their diabetic condition. On account of this data, the game's system model was adapted into a form of a feedback loop to encourage young patients to constantly cope with and manage their type-1 diabetes treatment. The figure below illustrates how the rewards loop system was incorporated into this study.

Figure 8.2 *Model of rewards system aiming to change and improve the pattern of the diabetic patient's behaviour (Klangpremjit, V., 2019)*

According to the diagram above, the rewards loop system encourages the patient to engage with the game system. Meanwhile, the diagram above (Diagram 8.2) details how the game design elements that were summarised have been connected with the model of the rewards loop systems shown above. The model was divided into five categories based on the abovementioned diagram: (1) clusters of the users research comprehension; (2) designing the game's triggers; (3) the player's actions; (4) designing the type of rewards; and (5) the expected outcome in terms of the progress of the health-related behavioural change. The first section (in the left corner), exhibits the encapsulated clusters that identified the game's design triggers that were aimed at responding to each strand of the clusters shown in the right-hand side of the diagram. The lower-right section illustrates the player's actions that interact with and respond to each of game's triggers, which was reflected through the form of the rewards system that is shown in the lower-left section of the diagram. Both the player's action and the rewards section were sorted, based on the internal and external considerations. The lower section of the diagram presents the expected outcomes that can emerge from the repetitive looping of the above four sections. From the diagram, we can see the

summarised design concepts that were the product of the design methods conducted in this study.
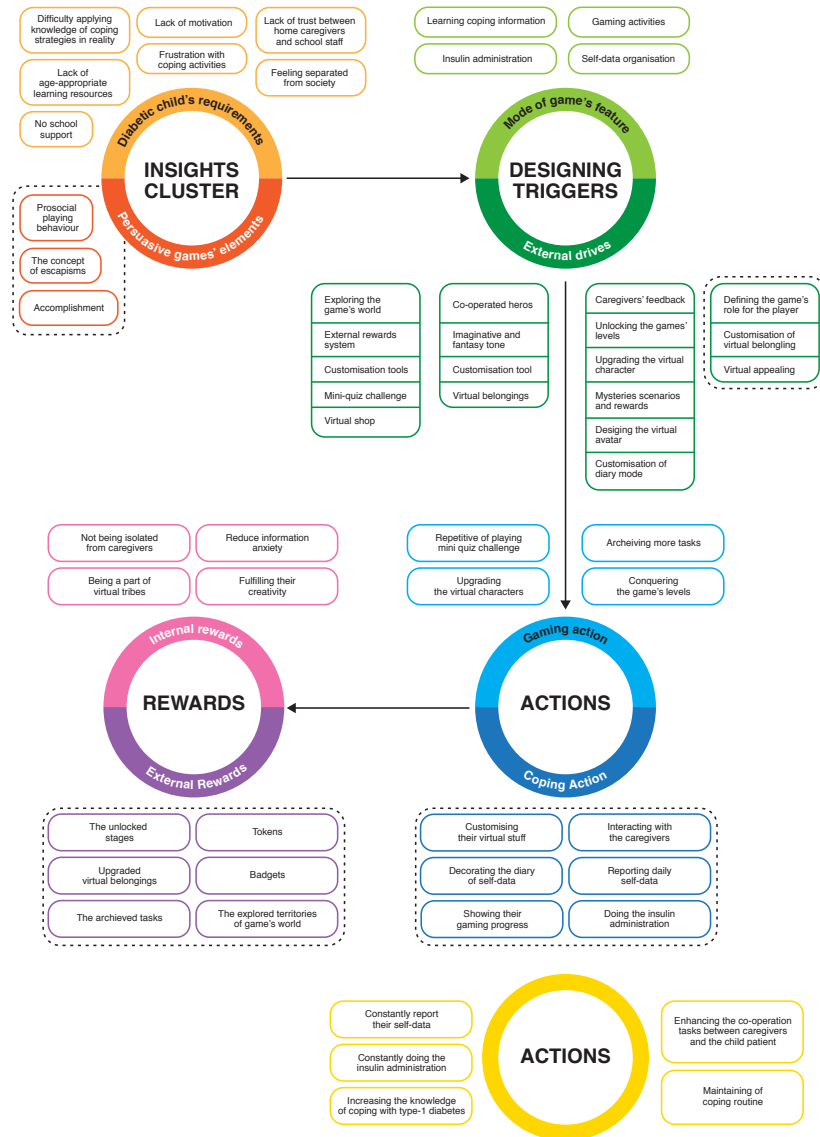
Figure 8.3 Model of the rewards system that was intertwined with the game's design elements (see the enlarged version in Appendix, D., p.404) (Klangpremjit, V., 2019)

To contribute new knowledge to the area of serious game design practice, this game research has provided the diabetic model of behavioural change from the perspective of the game designer, as shown above. This expanded the concept of the design boundary rather than filled the gap in behaviour science research. In addition, the system of feedback loop rewards that was transferred into one of the game's elements (mechanics standpoint) also provided a new finding by demonstrating how a feedback loop system

244

in the form of a rewards system was placed in the stage of the game for behavioural change (see Chapter 7: Design evaluation, p.181). The model of the rewards feedback loop was placed in each stage of behaviour change.

The actions that occurred in each stage of game play can be summed up in the concept of the game's design triggers to be posited in each stage of behaviour change. The design triggers that determined each stage of the game were built upon the core motivations embedded in each of the game's element, based on the fieldwork data and the playtesting responses. The above mentioned models intended to amplify the current knowledge contained in the studies on serious games in relation to behaviour change. The study found that the concept of repeating the rewards loop in each stage of the game could encourage the child player to manage their condition. Besides, it was also convenient for the serious game designer to manipulate the set of coping information data for the patient users as it was allocated into several stages of healthcare perceptions.

In Chapter 7 (p.181), the section on playtesting revealed that the players and their caregivers also reported that designing the game into the different stages meant it was also easy for them to track the progress of the behaviour change outcomes. Exploring relevant research related to the psychology of healthcare suggested this study must engage with the rhetoric on behaviour change models that aim to intertwine the notion of compensation with the stages of change in the game's structure, which include, for instance, the TTM (TransTheoretical Model), the health belief model and the self-determination theory (Thompson, D., Baranowski, T., and Buday, R.,2010).

This study discovered the gap in the field of serious game practice was that there are a lack of studies that state the comprehension behind interlinking the understanding of specific cultures into the games' design elements that are divided into four elements of game architecture. This concept provides readers with an extended knowledge of the field of serious games design practice. From the researcher's game design experience, the extended version of the model of diabetic children's behaviour change in the Thai context can be used in practical terms to develop a persuasive serious game intervention for the Thai game designer, based on both the playtesting activities and the responses.

8.1.3 Discussions of the methods applied
In this section, the methodology used within this study is discussed. To clarify, the research methodology applied was reiterated in several stages of the research in terms of how it affected the game design considerations. Revising the relevant studies provided knowledge of the common aspects of the research methods commonly used in the

relevant academic studies, which helped navigate the research direction. First, there is no concrete methodology for selecting the appropriate method for designing the diabetes game, specifically in terms of the demographic. In this study, the concept of the specific demographic was considered to be a crucial part of the persuasive factors that influence the particular users' motives on digital game playing. Hence, the study was designed based on each strand of the research questions that were determined at the beginning of the study (Chapter 1: Introduction, page, 1). The research investigated the productive game play experience through the lens of ethnography, while the strand of type-1 diabetic children and their caregivers' requirements was explored through the lens of phenomenology. Designing the methodology in this study has been discussed in Chapter 4 (Research Methodology, p.66).

Three subsections are included in this section: (1) a discussion of the methods that were used to identify the requirements of the diabetic child and their family; (2) a discussion of the methods that were used to define a meaningful gaming experience and playing motives; and (3) a discussion of the methods used to formulate effective persuasive game elements for the young diabetic players through both of the design prototypes. This section aims to reflect how each method has been used to achieve the ultimate goal in each section of this research. Throughout this research, data that emerged through interview and observation methods can serve the first strand of the research question determined in the early stages, defining diabetic users' requirements to help the designer to define the game's features. Meanwhile, the other strands of the research questions were designed using several methods that could be supported through the ethnographical qualitative research traditions.

First, to determine the problems with nursing strategies, a phenomenology-based method was used. The study found that understanding the paradigm of phenomenology allowed for the deciphering of diabetic children's living experiences in this specific context. Broadly gained from a myriad of sources of information, this methodology narrowed the study down to the in-depth data that truly related to the reality. The phenomenology-based research paradigm that was used in this strand of the research was the semi-structured interview. In the section on playtesting in Chapter 7 (Design Evaluation, p.181), it was shown that one consideration that should be marked at the initial stage of the interviews relates to 'building a rapport'. Based on one mistake that happened during the preliminary interview, some of the participating children pretended that they did not play any kind of digital games to show how well behaved they were, but this contradicted the data collected from one-to-one interviews which revealed that the child was very able to play the games. Sometimes, young participants will not reveal the truth of playing digital games if they were not accustomed to the interviewer, often

representing an ideal stereotype. This is especially so in the case of Thai society where playing digital games is regarded as bad behaviour. Hence, building a rapport between the interviewer and the young participants at the early stage of the fieldwork meant that the interviewer could meet the children more than once. Based on the experience of conducting this research, it was discovered that arranging to visit diabetic participants and their families several times led to uncomfortable circumstances for the family, which are shown in Chapter 7 (Design Evaluation, p.181). Therefore, dealing with a large number of diabetic participants seemed to be too difficult for the game researcher. In addition, some of the children on the hospital's list refused to participate in this study at an early stage.

Seeking children with type-1 diabetes in Thailand was extremely difficult but finding those that agreed to participate in the research was even harder, despite the fact that they had read the consent form that described the details of this study. Additionally, Thai parents did not seem to be accustomed to the idea of serious games helping patients to cope with health disabilities, at least at the point when this research was conducted. Using serious digital games to help them and their children improve their experience of coping with treatments and regimes was difficult to explain at the early stage of the fieldwork. An ambiguous and vague consent form could lead to the refusal to participate in this research. To solve this problem, it was essential to show potential participants some examples of success in the serious games design industry, which was expected to be the outcome of this study, to offer them a positive picture. It has been shown as an effective strategy for persuading individuals to take part in a case study, but discussion about digital games in Thailand is still far from being understood by Thai parents. The research also revealed that the Thai parents who had a child aged five to six were born in the era of the mid-70s and mid-80s (based on the data from the questionnaires), and lacked an understanding of how this kind of digital game intervention can be incorporated into the strategies for coping with type-1 diabetes.

Several research methods have been used to respond to the problem of coping with the diabetic requirements. These support insights where the caregivers' responses related to the problems the children were experiencing showed that some parental perspectives were different from those reported by the diabetic children. For example, three diabetic children who reported that they can cope with this condition by themselves mentioned that the basics of the therapeutic information were taught at the early stage when they were first diagnosed with type-1 diabetes. However, their parents reported that their children still could not deal with the treatment regime properly after meeting the doctor. This was underlined by the data from the fieldwork that showed that six of the eight diabetic participants did not know the basics of the coping regime in terms of, for

example, knowing how to deal with unbalanced sugar levels and having some knowledge of healthy food intake.

In the design process phase, an iterative technique was used to validate the principles gained from the fieldwork to formulate the diabetes games' design disciplines. The iterative design activities in this study were used to develop the diabetic game, by using the feedback on the initial prototype to support the design of the final game model. Based on this design method, the study exemplifies how the iterative game design process can be applied to game study in terms of being used as a methodological guideline for further game research.

Secondly, in terms of the methods used to define the productive factors of gaming experiences, the researcher used several methods of ethnographic tradition to respond to this strand of the research questions. When conducting the focus-group interviews, the young participants were easily influenced by the answers of other children in the focus group. This study also showed that the classroom atmosphere affected some of the answers from the young participants and the other children's opinions. Based on the observation data, it showed that the participating children wanted to be a part of the group interview, and that they did not reveal their opinion openly so they did not contradict their peers. This finding showed that some of the young participants were afraid to offer their opinions and many lowered their voice, hiding behind friends and keeping their hands down when the common answer was not relevant to his/her perspective. This was represented through the idea that once the leader of the interview groups had answered the questions, another child seemed to give the same answer. Hence, focus group interviewing may provide unreliable data. To tackle this problem, the participating children were encouraged to provide many answers to each interview question by repeatedly asking the same question and urging each child to respond with a unique answer. In addition, manipulating the interview atmosphere encourages children to have more energy and to share their thoughts with the interview group. This notion can be used to optimise the method of focus group interviews with young participants.

The drawing activity method was used in this study to encourage the young participants to reveal their expectations for serious game designs without any interference. From the researcher's perspective, observing their behaviour while they were drawing or designing their games showed the children were engaged with this method and that it was productive for them to freely draw their conception of the ideal game. Drawing and children seem to be highly related and this activity can exhibit the common visual language that reflects the thoughts of a child at this early age. In this project, the drawing enriched knowledge on the persuasive and meaningful, playful elements

through understanding the signs in the children's drawings (N=90) (Appendix B-7, p.386). In Chapter 3, the relevant academic research was reviewed that tended to implement some comprehension of productive diabetes games intervention.

Using the technique of semiotic analysis in drawing evidence to find out the productive factors of playing digital games, is not common in the field of serious game design practice. This project summarised that analysing the data from drawing can enhance design insight as it was reflected through the opinions of the child players. In addition, learning from each insight from the research methods applied in this study helped to amplify deep insights into the mechanics of serious games. Some data was contradictory, but this allowed for the re-evaluation of opposing views, leading to the affirmation of insights that supported the validation of arguments set up in the early stage of this study (research questions).

Lastly, in terms of the methods of the iterative game design process, these were separated into three main design phases: (1) understanding the user's desires and requirements; (2) the initial testing design (Garden Tower); and (2) the final design prototype (Rocket Ninja). The details of each design phase were provided in chapters 6 and 7. Therefore, this section will reflect upon the methods for the design steps applied in this research. The project showed that the feedback gained from the final design prototype provided the design principles as refined from those found in the initial design stage. Some significant data appeared to be different from the previous stage, including the game design content that had been altered from garden to space content. Moreover, the aesthetics of the game design that aimed to appeal to children of this age were identified in a different way than with the fieldwork data because at the fieldwork stage, the children represented their thoughts on digital games only, which was different from the playtesting stage, where the children had the game in their hands. Additionally, the two phases of the model prototypes also provided the players' feedback, which helped us to develop a system that would appropriately serve the targeted users.

8.1.4 Reflection on the game model prototypes produced in this study

Two game prototypes were designed for this research, based on the understanding of relevant research in order to determine the strategies and methods they applied that could help people cope with diabetes' The iteration of the design process and the evaluation stage are discussed in Chapter 7 (p.181).

"The Garden Tower" was designed based on the understanding of existing relevant studies prior to the user testing and fieldwork data which related to two of the research questions, which were: (1) what constitutes a meaningful digital game experience; and

(2) what are diabetic children's diabetic coping and game design requirements? The mechanisms behind "The Garden Tower" meant that the player also had the ability to customise, expand and decorate their own space as a result of the patient's coping performance in daily life. The development of this game was represented through the form of the horizontal extended space in the garden, as is implied through the name of this game. The game offered the players a digital gardening experience, along with a mode of learning about appropriate food intake for diabetic children, through the 'My Kitchen' feature, which permitted the diabetic children to create their own dishes. Diabetic players could also cook their recipes by using the ingredients harvested from the gardening feature. In every activity related to coping with type-1 diabetes, the results were turned into tokens that allow the player to expand their ability to manage their garden in terms of, for instance, extending the garden space, buying more ingredients, creating more recipes and growing more crops.

To produce the prototype of *The Garden Tower*, the Java game programming language was selected. However, it was discovered that non-responsive features and errors occurred after the game was produced, which affected the players by offering responses that indicated the difficulty experienced in the system by the players. *The Garden Tower* prototype was sent to the diabetic participants via email in the form of an .APK file. The file could be opened through the Android system and through the Chrome application, in the case that the participants were not using smart phones with the Android system. Chrome is an Internet platform that can be operated by both the Microsoft and the Mac IOS systems. The reason for using Android readable software was that it was cheaper than IOS in terms of the production and coding process. This is combined with the fact that more devices can access the Android system and the Android programme creators offer more opportunities for game programmers and designers than IOS operation systems, which only relate to Apple products at the high end of the electronic devices market. As .APK files can be read via Chrome, Firefox and Internet Explorer, making it easy for the participants to access the game.

Due to the complexities of JAVA coding, the process of finalising *The Garden Tower* prototype took longer than was expected in the early stages, while help was also needed from a game programmer, which led to higher production costs. As a consequence, another solution was developed to model the final game in the last phase of this study, the visual design for the final game, Rocket Ninja. This was represented in 2D form, and the game mechanism was not overly complex. Hence, it was easy for the game programmer to model up the final game prototype and it was not necessary to code it with a complex game generator, such as JavaScript (a scripting language for the web, not the same as Java).

The final game prototype, Rocket Ninja, was designed based on knowledge gained from the gardening game playtesting feedback from a previous stage. It is basically an RPG[85] game that encourages diabetic children to constantly deal with their coping regime via the space explorational content. The distance of the space exploration and the player performances depend on the diabetes coping performance, much like the gardening game. The players were allowed to build and customise their rockets to further explore the territories and planets in space in order to enlarge their Ninja's empire. The rewards system embedded within the game encouraged the players to achieve the game's tasks to enhance their ability to perform within the game system by creating virtual rockets, upgrading the rockets and collecting planets. This final game version was amended in accordance with the feedback related to the interaction between player and system. The understanding of the feedback was guided and categorised through underlining the methods used in the GUR (game users research). To finalise Rocket Ninja, GameSalad [86] was selected to generate the prototype as it was cheaper and can be widely operated via digital internet platforms available on mobiles and desktops. The researcher found that using Game Salad was much more convenient for game designers and programmers as it was easy to interpret, meaning no complicated coding skills were needed.

Considering the production of the game design prototypes provided feedback from the diabetic children in terms of interacting with the game system in their daily coping regime. In this study, certain factors constrained the finalisation of the model production. For example, the high cost of 3D visual design in the game field required the employment of a highly skilled game programmer. Hence, the budget and time limitations shaped the design decisions that were defined in chapters 6 and 7 (Design Research and Design Evaluation) such as, for example, the game's aesthetic, the complexities of the game's mechanics and the game's platform. The use of game design creators can also provide some advice in terms of selecting tools for future game research.

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[85] The term 'RPG' stands for Role Playing Games referring to the genre of games that allows players to situate his or herself into the game's world through narrative structure. Inside RPG games, players are able to impersonate their chosen role inside the game's world. In this research, some well-known RPG games are used to investigate the structure that aims to engage the player, for instance, Grand Theft Auto (GTA), Realm of Valour (ROV), and Pokémon Go!

[86] 'GameSalad' is a game creator software developed by GameSalad, Inc. It was created to promote the development and designing of games to produce mock-ups and prototypes without needed to possess complex knowledge of coding and text-based computer language.

8.2 Contributions to new knowledge

To accomplish the goals of this study, from the first stage to the last, the research activities undertaken have provided new insights that can contribute to knowledge in the field of serious game design, specifically for young diabetic patients. A number of existing studies explored the area of serious games for type-1 diabetes patients with the aim of improving their coping strategies. However, this research expanded knowledge related to the factors for persuasive serious games that target these specific users. Hence, this thesis provides a new set of understandings in terms of specific requirements, the uniqueness of the barriers to coping with type-1 diabetes, and children's motives for playing digital games based on geographical influences. These factors all play a crucial part in the game design field.

Additionally, the findings that emerged here emphasise the factors that impact on the perceptions of Thai children and their attitudes towards digital game playing. Alongside the data gained from this research, these findings provide extended knowledge in this area of serious game research from the designer's perspective, which highlights the concept of interlinking game design theory with the model of behaviour change. The knowledge gained in this study was based on existing research and studies, as well as the data garnered through the research methodologies used to frame the study. These new design approaches serve to fill the gap in research on serious games for the healthcare industry. The points below detail the new knowledge discovered through this study.

Serious digital games for Diabetes Type-1(and other ailments facing young children) treatment assistance and monitoring can mitigate against the following issues by:

- Providing coping strategies in Thailand to overcome the barriers and regulations relating to the support for type 1 diabetes patients, which can make it difficult for children and their caregivers to adequately monitor their treatment. The research created a system within the game that provided an interactive feature, specifically a space that allowed children to update data related to their condition. This study revealed that, by having transparency between patients, caregivers and school staff, trust can be promoted, and caregivers' anxiety reduced. Furthermore, when at school, the children are encouraged to upload their real-time diabetic status into the system.

- Increasing the communication between home caregivers and school staff, which makes it easier for caregivers to properly monitor treatment. The games prototypes were mainly targeted at diabetic children at this specific age. The study demonstrated that, by using the interactive feature to record data, children's creativity is enhanced, and their imagination stimulated, which was reported as being a suitable technique

for a diabetes game. Based on this notion, these sorts of gamified techniques can be used to increase communication between child and caregivers, as well as school staff.

- Providing a source of appropriate coping-related data for children aged between five and six in Thailand. Because there is no diabetic heath game for early aged children in Thailand, this research provided specific young diabetic children with appropriate sources of learning data through the serious games intervention. The research examined the learning capabilities in regard to coping activities of diabetic children aged five to six years and found three modes of instruction to be appropriate: teaching about appropriated insulin levels, teaching about appropriate food choice, and leaning about insulin administration in their daily life. Additionally, the research found that the complexity of learning to cope with type-1 diabetes strategies can be simplified through the concept of 'elucidating' mentioned in section 2 (p. 245).

- Understanding and clarifying the core aspects of motivation shaped and influenced by Thai society of Thai children aged five to six in terms of playing digital games. Based on the fieldwork data, the research argued that society has shaped attitudes and motivations behind playing digital games of children of this age in Thailand. This is reflected through three aspects: (1) the difference between the genders in regard to their interest in digital games' contents and aesthetics (discussed in Chapter 5, p.100); (2) representations of the concept of prosocial behaviour; (3) contents that allow children to escape reality. This study argued that game mechanisms that evoke such feelings can be designed to offer a variety of role-play characters as a part of virtual tribes. Additionally, to promote coping with diabetes, reporting their current status regarding their insulin levels and food intake can promote the prosocial concept as well. A contradiction between caregivers' and children's responses with regard to How to develop ideal game contents for players of specific ages exists in educational media. Research reveals that in Thailand, some educational game contents are too close to reality, which makes the games less interesting.

- Providing a set of data related to the requirements of Thai diabetic children and their families for serious game designers. This study provided a set of data that identified meaningful and persuasive factors that can be used to design health games for specific users by means of the concept of motivational core drives of digital gameplay discussed in chapter 5 and by harnessing diabetic patients and their caregivers' requirement in game elements (p.251). This study also worked out scenarios involving diabetes children and their caregivers that indicated their problems with coping with type-1 diabetes in Thailand. Additionally, the data in this study showed how game designers design game design mechanics based on case studies that used fieldwork data visualised in the diagram in chapter 5 (p.129).

- Demonstrate the key link between game design elements and diabetic children's requirements. This study suggested four elements of coping with diabetes based on fieldwork data: (1) learning-based scenarios, (2) game-based scenarios, (3) self-data management scenarios, and (4) cooperation tasks. Based on these four elements, this study suggested that each scenario should be integrated into the games system. Based on the feedback for the tested games, resumable and non-narrative structures were suggested for diabetic children. The games should be a part of diabetic children's daily routines based on their coping activity schedule for; the games should not just be used for entertainment purposes. Further, the study revealed that implementing a rewards system in the form of virtual objects effectively promotes co-operation among caregiver and diabetic child and ensures consistency in reporting and monitoring self-data.

- Providing a model for game design intervention, interconnected with the stages of behaviour change in diabetes patients. The game design prototypes in this study were applied to the stages of behaviour change in the form of unlocking the game's world. The study concluded that learning of coping strategies is supposed to be done in logical order, from easy steps to complex steps. The division of the stages of the pattern of behaviour change was represented in this research in five different stages, visualised in image 8.4 (p. 252). The study argued that providing a looping rewards mechanism for each stage of gameplay can improve frequency of monitoring and reporting of diabetes status, including insulin levels, daily food intake, and daily insulin intake. Additionally, learning to use coping strategies should be integrated into every stage of gameplay, and the difficulty of each subsequent level should be slightly increased. Based on the feedback for the final prototype, this research revealed that acknowledging coping strategies through the mode of a mini-quiz challenge limited the frequency of access to the diabetes game during the day.

Furthermore, the research methods used also enabled the production of a number of critical recommendations for the appropriate considerations and methods to be used in future serious games research. The points below represent new knowledge that emerged through the selected mix of research methods and what emerged, in terms of game development, such as:

- It is critical to employ physical objects (such as toys and pictures) into research activities to enhance responses from young interviewees, and to engage them with interactive activities during the interviews; and

- Various methods of qualitative research can validate the data gained from each strand and emphasise the significant data in other methods necessary for good serious game design.

The evaluation of the children's drawings as evidence of social portrayals of game play attitudes and perspectives of Thai children, through the lens of social content analysis within a specific cultural context, provided great insight.

To summarise:

As shown in the Image 8.3 (p. 251), this thesis encapsulates the contribution to new knowledge that emerged from this research through these four sub-categories, responding to the diabetes games' objectives, which are; (1) appeal, (2) understanding, (3) usability and, (4) player experience.

8.2.1 The strengths of this research

The project has endeavoured to clearly identify the persuasive game intervention outcomes to address the problems of coping with diabetes treatment regimes. The outcomes of this study includes diabetic game design disciplines that fills the gap in the knowledge on serious game design studies for specific users. The strength of this research can be extended to three dimensions: 1) the unique blend of the methodologies applied in this type of study; 2) the uniqueness of the insights that emerged from the circumstances of this specific context; and 3) the game outcomes of this research, based on iterative design procedures.

Various qualitative research methods helped to identify the complexities of a meaningful game experience and the persuasive factors of young Thai children, which will help other game designers to link the understandings with the unique model of behaviour change used here. The advantage of using these research methods lies in the fact that the data that emerged from the participants validated each method and could also be used as affirmative facts, based on a triangulation strategy, which provided valid sources for the game researcher.

The model of the game prototyping, developed from the deep insights gained through the qualitative research methods moved the project toward serious game design interventions. In addition, the knowledge gained from the iterative game design evaluation applied in this study also helped to formulate the practical data, harvested from social science research paradigms. Hence, the findings gained from this study not only offer empirical findings to enrich the pragmatic knowledge on game studies research, but also deliver a set of understandings of the social phenomena related to the problems of being a diabetic child in non-supportive contexts.

8.2.2 Limitations of this research

The limitations of this study are discussed in this section through three main categories: (1) the limitations of the research methodology, (2) the limitations of the prototype production and (3) the limitations of conducting the playtesting activity.

First, finding appropriate diabetic research participants was difficult, since there is a lack of registered children with type-1 diabetes in the central healthcare system in Thailand. This is due to the fact that at aged five–six years old, it is hard to observe any signs of type-1 diabetes. However, in addition to the lack of subjects in the Thai context, the lack of willingness to participate in this project was also an obstacle to conducting the fieldwork. The participants in this study were finally accessed through personal acquaintance, and through the researcher's connections. Nonetheless, the research had to be conducted with a limited number of diabetic participants. In addition, conducting the research with normal children meant it was hard to gain permission from several schools in Thailand, since the fieldwork could have disturbed the normal school activities. In the early stage of the fieldwork, ten schools were contacted in different locations through phone and email. Half of these schools declined to participate because the focus group activity, the observation and the drawing activity might distract the children. In fact, this reiterated the fact that many schools appear to be unaware of the importance of dealing with children with type-1 diabetes.

Second, in terms of the production of game prototypes, there were some limitations that constrained the project in terms of designing the diabetic game. In short, the games' design aesthetics were restricted by budgetary and time-scale limitations. In the game designing stages, a balance had to be struck between player requirements and the capabilities of the researcher to produce the demo version of the diabetic game. 3D modelling of the visual aesthetics within the game's sphere led to high costs and also took a long period of time to finalise. To solve this problem, another type of visual approach was sought to attract young players to the final diabetic game. In Chapters 6 and 7 (Design Research and Design Evaluation), the aesthetic design considerations are discussed. For instance, 2D computer graphics was used to appeal to the children at this stage. Meanwhile, a few errors (bugs) occurred in the process of playtesting because of the low budget production. Relying on this circumstance led to the negative feedback that came from the participating diabetic players. In addition, providing the storage server to connect the diabetic child patients in Thailand to formulate a specific social circle through the game was difficult because of the high cost of production and also because of the requirement for a skilled technician. However, based on the main objectives and aims of this project, the knowledge that focussed on the technical aspect was not specifically targeted.

Third, in terms of achieving the response to the playtesting activity, the limitations meant that problems occurred at the playtesting stage, which were similar to those of the stage of conducting fieldwork data, which were mentioned above. Due to the focus on the specific targeted users, after receiving the playtesting feedback on the initial design prototype, a further year was needed to analyse and evaluate the final game design. The final stage of playtesting the design testing the prototype began in 2018, which means that the diabetic participants who took part in this research were now older than the targeted user (five-six years of age). Therefore the stage of testing the final prototype required finding a new set of diabetic participants to ensure the relevance to the targeted users was retained. It was also discovered that this stage was harder than the earlier stage, because it included a number of home visits and one month of game playing to receive the feedback. Additionally, in terms of demo game prototype production, the time-scale of this research constrained the framing of the diabetic game's lifespan to one month so it could be tested and so feedback could be received within the required time-frame.

8.3 Suggestions for Future Research

Throughout the research, the insights gained provided a deep understanding of how the game design elements could be harnessed within the model of behaviour change for type-1 diabetic children, in a specific geographical context. The knowledge gained from this research process has extended insights in the area of serious games for health in terms of understanding the surrounding contexts that shape player behaviour and the attitudes toward playing digital games. In Chapter 7, diabetes games design disciplines were illustrated. This research fills the gap in the research previously performed in terms of exposing the persuasive factors that are shaped by limited diabetic facilities and significant cultural perceptions. By illustrating and visualising through diagrams and info-graphics, it may help game researchers to easily decipher the models of the serious game elements that were shown to be intertwined with the model of patient behaviour change. Two main subsections of this research could be implemented within the field of serious games research: (1) using the games' mechanisms to develop interventions to improve patients' coping experiences; and (2) the comprehension of the games' mechanisms in order to enhance player motivation.

First, the model of behaviour change that was harnessed within the game's mechanisms, was selected at the end of the research (p.250). Based on the career experience of the researcher, this model might be effectively applied to other disability-related contexts with the aim of improving coping experiences, such as asthma treatments, dietary

programmes and physical rehab. The understanding of the motivation of players led to the generation of game design triggers at the first stages of the games design. This provides support for a game researcher to adapt the insights for future game studies. The diagram 8.3 Thai players' motivations, so the understanding of them can be adopted within future research in this area, specifically for the Thai game market.

Based on the methodologies adopted for this research, the core motivations were validated through the iteration of the game design process and the playtesting feedback. The diagram 8.3 also shows the overall game design elements that could be harnessed to cope with other, similar coping treatments for disabilities.

First, from the game designer's perspective, further game design research could also apply the insights relating to the meaningful digital game design elements in order to develop the serious games. Using several methods of research as a counterpoint technique can also be used within future serious games research, based on the design procedures, such as using a drawing activities as a research method to affirm the insights and enhance the responses of the participants and the experience of game playing for young children. Understanding this strand of the research can guide others better when designing for young players in the Thai context.

Based on the feedback of the final game's playtesting activity, embedding the feature that allows the diabetic player and their caregivers to exchange their coping techniques for type-1 diabetes with other players was emphasised by the participants. In this study, the function of an open virtual world[87] was not fully operational, due to the limitations stated in the previous section. As a consequence of this suggestion from the participants, it is recommended that further game design research consider the content of an open diabetic virtual world for Thai diabetic children. Additionally, the connecting Thai diabetic patient through the game system can reduce the anxiety for diabetic children and their families coping with their condition in Thailand. However, the open virtual world was not the only aspect gained from this feedback. In fact, diabetic participants also recommended connecting the game with the real-world experience and also using new technologies, such as virtual reality and QR coding. This also included focusing more on designing a customized experience game experience when the diabetic child is first diagnosed with type-1 diabetes, including providing a basic coping condition,

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[87] The term 'open world games' is discussed in this thesis as one of the features used to create an engaging experience for targeted diabetic players in this study. In this study, open world games refer to games with borderless world maps. Additionally, open world refers more to the freedom of movement within the game to travel anywhere within the boundaries of the map, rather than being restricted into traversing certain pathways. Not only the player can explore the games' world territories without requiring loading time, but the game also generates its space to be easy for the player to socialise through the player's avatar. Famous games which are marked as references for this study include Grand Theft Auto (GTA), Ragnarok Online (RO) and Pokémon Go.

hospital experience, school activities or even having contact with other people, rather than focusing on transferring the games through the online application. One of the intriguing ideas, which emerged related to using the game intervention, was intertwined with QR code technology, to deal with nutritional information on supermarket food packaging to enhance the learning experience of appropriate daily food intake (see the section on playtesting, Chapter 7, p.211). This idea could be an effective tool to promote the understanding of food choices in the real world, which is particularly worth considering if applied alongside the games' mechanisms.

These suggestions gained from the feedback can support game designers to explore new knowledge in the area of serious games to support type-1 diabetes management and other conditions.

8.4 Conclusions

This chapter has provided conclusions on the insights gained throughout this study. It also reflected the perspective of players in terms of serious games for health care in Thailand, by discussing the different aspects that shaped the diabetic game's design features.

Once the data from the feedback on the initial design game The Garden Tower had been compiled, the final mock-up, Rocket Ninja was ready to be evaluated. This final version of the diabetic game was designed based on the themes synthesised from the second user testing fieldwork outcome, which were separated into four main features: (1) instructional mode, (2) insulin administration mode, (3) game mode, and (4) diabetic self-mode.

The findings that emerged were collected through various qualitative methods aimed at a young group of players. The data that has emerged can navigate designers toward using these insights to define their initial game's design guidelines in the first stage of game design. Due to the process of designing the game design outcomes, the findings contributed new knowledge to fill the research gap in the field of serious game studies, focusing on the type-1 diabetes condition. This could help future game designers to develop their own persuasive diabetes-related games that target young players. The findings from this qualitative study identify a set of pragmatic serious games design guidelines for game designers, which demonstrates the contribution to new knowledge through these four sub-categories, purposed to respond to diabetes games' objectives

In the games design industry, the number of companies, such as Electronics Arts[88], Ubisoft[89] and Kings[90], which intend to understand player experiences and user-playing motivation is increasing (Zammitto, 2019). The learning experience that the researcher has gained from this period of the thesis provides him with the ability to conduct game user fieldwork research, interpreting their requirements and interlinking the data into game design thinking. Based on the harvested knowledge in this study, the researcher can also apply this skill in the role of game user researcher in large and small companies. Additionally, understanding the Thai children's market can give the researcher opportunities to guide the design of a game that meets such requirements in a future project. In terms of serious games prospect, this study gave the researcher a better insight into how the game designer can apply the games' mechanisms into the condition management, which promote the patients' coping experience.

Additionally, after conducting the thesis, this study provided the researcher with further understanding of designing games for early-age children that enhanced his skillsets for his future career as a game designer. In the future, the researcher aims to produce educational interactive media targeted specifically at early-age users and the conclusions of this study enable him to provide a set of engaging strategies for the target audience of future projects. In the researcher's opinion, not only did the findings evaluate games and interactive media for early ages users, but systematic design thinking and research management skillsets were also explored. Based on the knowledge gained from this research, the researcher is interested in joining the edutainment interactive tech start-up in Thailand, purported to be a pioneer of start-up tech exploring the interlacing between persuasive game strategies and the concept of behaviour change. To conclude, the experiences gained from this research are considered as the foundation of the researcher's future career as a game designer.

Hence, carrying out serious games design in Thailand, where there are only a small number of serious game practitioners would be a step in trying to encourage Thai people to recognise and realise the potential of using games to promote healthcare condition. Getting to know the users not only increased the researcher's comprehension of Thai children, but also presented good opportunities to meet people working in the healthcare

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[88] 'Electronic Arts' is an American games producer known as 'EA games.' The company has launched a massive amount of games that run on a myriad of platforms including, PlayStation, computer, Nintendo consoles and mobile phones. The well-known games launched by this company include: FIFA, The Sims, Need for Speed, and Star Wars: The Old Republic.

[89] 'Ubisoft' is a French games company. The company has created famous games such as Assassin's Creed, Far Cry, Just Dance and Rayman.

[90] King.com Limited was founded by developers Riccardo Zacconi and Toby Rolland. The company is known for specialising in social games: games that are supportive of players' social interactions. For instance, players are interconnected through competition in the form of a leaderboard system, chatting and cooperating on tasks within the game's storyline. In 2012, the company launched the famous series, the Candy Crush Saga.

industry. Knowing such people can assist the researcher in being regarded as a serious game designer and to conduct game research more easily in the future. After graduation, in my future career, I intend starting a business to produce games for people with disabilities with the aim of increasing patient motivation, or even promoting physical activities.

Every day, in the game design business in general, and even every serious game design in the industry, there are new insights, data and new technologies that extend the area of design practice. The researcher believes there is a desire for such a change in the serious games industry to improve the healthcare experiences of diabetic children.

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