Playing games is serious fun!

A serious game for type 2 diabetes patients to enhance a healthy lifestyle

Arnica F.B. Wijers

Playing games is serious fun!

A serious game for type 2 diabetes patients to enhance a healthy lifestyle

MASTER THESIS

Arnica Wijers (s0074667)
University of Twente, Enschede
School for Management and Governance
Master Healthcare Management

Commissioned by Medicinfo
First supervisor University of Twente: Dr. J.E.W.C. van Gemert-Pijnen
Second supervisor University of Twente: Dr. Ir. A.A.M. Spil
Supervisor Medicinfo: B. Brandenburg MD

Preface

Almost two years ago I followed the Course "Behavioral Aspects of Quality of life". During this course my interest grew for eHealth applications and I decided to do my Master Thesis about an eHealth application. However, the field of eHealth is rather broad so it was difficult to choose. Until, Bart Brandenburg gave a guest lecture during this course and paid attention to the emerging field of serious gaming in health care. It became clear that there are possibilities for this field, but that more research was needed about how serious games could be successfully designed and implemented. During this lecture I was enthusiastic and skeptic at the same time. This was the perfect motivation to do my Master Thesis on this topic.

Meanwhile, nine months of research have passed. A period in which I met several challenges. At the beginning of this research I thought that doing research was a process in which I was the one that could guide the process. That I was responsible for the outcomes of the research. When things went wrong, I thought that I made the wrong decision or that I did not work hard enough. I also thought that working hard was measurable. That it would yield visible outcomes.
Later on, I realized that taking time to over think things is also working hard. Despite that it not always showed visible results. Days that seemed unproductive or useless appeared in the end to be a grab bag full of valuable thoughts.

This is only one of the things that I have learned during this research, but I think that this is for me the most valuable lesson and therefore worth mentioning. I am glad to realize that I have learned a lot during this research and that I proudly can present this Master Thesis as the result.

Of course this was not possible without the support of others. Firstly, I would like to thank my supervisors of the University of Twente, Lisette van Gemert and Ton Spil, for their guidance, support, and advice during this research. Furthermore, I would like to thank Bart Brandenburg for his support and the possibility to get to know Medicinfo. Special thanks to Nicol Nijland, who actively thought along in during this research, learned me to become a better writer, and accompanied me at Medicinfo.

I also want to thank my family and friends for being there for me. Most of you felt just at the right time when I needed a good conversation or when I just needed to make some fun. You are very valuable to me.

This research would not have been possible without all the people that participated during the survey, interviews and focus group. I would thank them all for their time and valuable ideas.

Last but not least I would like to thank my boyfriend David Nijhof. I gave you a hard time, but you always cheered me up and motivated me. Also thanks for all the valuable comments you made during this research.

Arnica Wijers,
Utrecht, September 2009

Samenvatting

Introductie

Een groeiend aantal mensen speelt tegenwoordig computerspellen. Dit zijn niet alleen kinderen en pubers, maar ook volwassen mannen en vrouwen. Computerspellen worden niet alleen gespeeld voor de lol maar ook voor serieuze doeleinden. Computerspellen die niet alleen de nadruk leggen op entertainment maar ook op een serieus doel worden ook wel *serious games* genoemd. Serious games worden in verschillende sectoren ingezet, zoals in het bedrijfsleven, bij de overheid en in de gezondheidszorg. Dit onderzoek richt zich op serious games in de gezondheidszorg, met de nadruk op een serious game voor type 2 diabetes patiënten dat een gezonde leefstijl stimuleert. Er is gekozen voor een game voor type 2 diabetes patiënten, omdat cijfers laten zien dat het aantal type 2 diabetes patiënten snel toeneemt. Ook zijn er een toenemend aantal type 2 diabetes patiënten onder jongeren. De hoofdoorzaak van de ontwikkeling van type 2 diabetes is overgewicht. Om type 2 diabetes te voorkomen, of de klachten te verminderen, is een gezonde leefstijl waarbij gezonde voeding en voldoende bewegen centraal staan erg belangrijk. Het veranderen en volhouden van een gezonde leefstijl is niet gemakkelijk. Bestaande interventies hebben tot nu toe tot onvoldoende uitkomsten geleid en vaak spreken de interventies vooral vrouwen aan. Dit geeft aan dat er een extra benadering nodig is die ook mannen aanspreekt. Cijfers van de Entertainment Software Association (ESA) tonen aan dat computer spelletjes zowel door mannen als vrouwen gespeeld worden. Daarnaast heeft onderzoek aangetoond dat serious games ingezet kunnen worden om leefstijlverandering te stimuleren en vol te houden, omdat computerspellen makkelijk af te stemmen zijn op de individu en een veilige, interactieve en boeiende omgeving bieden om te experimenteren.

Het doel van dit onderzoek is om de eisen en functies waaraan een serious game, met als doel het veranderen van eetgewoonten en een inactieve leefstijl van type 2 diabetes patiënten, moet voldoen zodat het nuttig is en volwassenen aanspreekt.

Dit onderzoek is uitgevoerd in opdracht van Medicinfo. Medicinfo is een innovatiecentrum gericht op de gezondheidszorg.

Onderzoeksbenadering

Voor dit onderzoek is een onderzoeksmodel opgesteld dat is gebaseerd op een user-centered design. Dit houdt in dat er vanuit de potentiële gebruiker is gekeken naar de eisen en functies waaraan de serious game moet voldoen. Het onderzoeksmodel bestaat uit twee fases. De eerste fase bestaat uit een exploratie van het veld van serious games in de gezondheidszorg met een focus op serious games die tot doel hebben om gezondheid gerelateerd gedrag te veranderen. De tweede fase is gericht op de identificatie van de behoeften van de potentiële gebruikers. Gebaseerd op de literatuur is besloten om onderscheidt te maken in geslacht, leeftijd en vrijwilligheid. Vrijwilligheid verwijst naar de context, vrijwillig of verplicht, waarbinnen het spel gebruikt wordt.

Voor de dataverzameling zijn verschillende methoden gebruikt, omdat verschillende type data verzameld moest worden en omdat er meerdere doelgroepen zijn ondervraagd. In de eerste fase zijn een literatuurstudie en een survey uitgevoerd. In de tweede fase zijn gestructureerde interviews, een focusgroep en interviews met experts uitgevoerd. Gebaseerd op de behoeften van de verschillende doelgroepen konden de eisen en de functies waaraan de serious game moet voldoen worden opgesteld.

Belangrijkste conclusies

De resultaten van de literatuurstudie laten zien dat er nog weinig serious games die gericht zijn op gedragsverandering voor volwassenen zijn. Hierdoor was er weinig bekend over de behoeften van deze doelgroep. Met dit onderzoek is een eerste stap gezet om hier meer inzicht in te krijgen.

Vooral mannen gaven aan het er mee eens te zijn dat een serious game kan ondersteunen bij het veranderen van de leefstijl. Dit betekent echter niet direct dat zij de serious game zouden willen gebruiken. Desondanks wilde meer dan de helft van de mannen het spel gebruiken. Een significant kleiner percentage vrouwen is het eens dat een serious game kan ondersteunen bij leefstijlverandering. Ongeveer een even groot percentage zou de serious game ook willen gebruiken. Het lijkt er op dat voor vrouwen het geloof in het nut van de serious game leidt tot het gebruik ervan. Dit is in tegenstelling met de literatuur.

Uit de gestructureerde interviews kwam naar voren dat jong volwassenen (leeftijd tussen de 20 en 25 jaar) een serious game vooral zien als een middel om te ontspannen. De belangrijkste eisen en functies voor de serious game zijn volgens deze groep:

- Interactie. Door een twee speler optie aan te bieden.
- Competitie. Door het opbouwen van de reactietijd.
- Motivatie. Een 'echt' persoon geeft advies.
- Afstemmen op de individu en doelen stellen. Door vooraf persoonlijke gegevens in te voeren.
- Feedback. Zowel tijdens als na de sessie.
- Actief zijn. Door intens fysieke activiteiten aan te bieden.
- Voorbeeld gedrag tonen. Door zelf in het spel zichtbaar te zijn of door zelf een karakter te maken.
- De omgeving moet er realistisch uitzien, maar hoeft niet zeer gedetailleerd te zijn.

De focusgroep, uitgevoerd met type 2 diabetes patiënten (leeftijd tussen de 63-72 jaar) laat zien dat deze groep juist een nadruk legt op het nut van de serious game. Dit kwam vooral naar voren in een sterke behoefte naar informatie. De belangrijkste eisen en functies voor de serious game zijn volgens deze groep:

- Informatie bieden. De informatie moet geschreven zijn, uniform en aangeboden worden in kleine hoeveelheden per keer.
- Beslissingen nemen. Door te kunnen kiezen uit verschillende antwoord mogelijkheden.
- Beloning. De moet aangepast zijn op de moeilijkheidsgraad.
- Motivatie. Door middel van een virtuele coach of echt persoon.
- Afstemmen op de individu en doelen stellen. Gebaseerd op persoonlijke gegevens
- Feedback. Zowel tijdens als na de sessie
- De omgeving moet er realistisch en gedetailleerd uitzien

De interviews met de experts laten zien dat men gelooft dat een serious game van toegevoegde waarde kan zijn voor diabetes type 2 patiënten, maar dat er wel getwijfeld wordt of deze doelgroep een serious game uit zichzelf gaat spelen. Daarom wordt door de experts aangeraden om het spel onderdeel te laten zijn van het behandel programma. De belangrijkste aspecten die volgens de experts terug moeten komen in het spel zijn:

- Een realistische omgeving
- Een omgeving die sportieve activiteiten stimuleert
- Middelmatig intensieve activiteiten
- Algemene informatie over voeding

De game ontwikkelaars geven aan dat het belangrijk is om te testen of type 2 diabetes patiënten het spel uit zichzelf spelen door het spel mee te geven naar huis. Tot slot is het belangrijk om in het spel het positieve effect van de leefstijlverandering te benadrukken.

Discussiepunten
Het belangrijkste discussiepunt met betrekking tot dit onderzoek is dat er een aantal aspecten niet getest konden worden, zoals de combinaties van eisen en functies. Dit was niet mogelijk omdat er geen prototype ontwikkeld en getest is. Daarnaast waren de steekproeven relatief klein. Dit heeft te maken met het feit dat de methoden niet altijd een grote steekproef toelieten. De keuze voor de methoden die gebruikt zijn, zijn gebaseerd op de doelgroep die benaderd moest worden. Hierdoor kon veel informatie per doelgroep verzameld worden wat tot een compleet overzicht heeft geleid van de eisen en functies waaraan de serious game moet voldoen.

Aanbevelingen
Naar aanleiding van dit onderzoek is aanbevolen om voor de ontwikkeling van een prototype eerst een grondig onderzoek te doen naar de behoeften van de eindgebruikers.
Aanbevelingen met betrekking tot de ontwikkeling van een prototype zijn: eerst duidelijk stellen wat het budget en tijdbestek zijn waarbinnen het prototype ontwikkeld moet worden.
Daarnaast is aanbevolen om eerst een prototype te ontwikkelen dat voldoet aan de belangrijkste eisen en functies. Daarna kunnen secundaire eisen en functies toegevoegd en getest worden.

Het is belangrijk dat tijdens de ontwikkeling van het prototype feedback wordt gevraagd aan de potentiële gebruikers en stakeholders. Tot slot is aanbevolen om twee prototypes te ontwikkelen, waarbij er één gericht is op jong volwassenen en één gericht op diabetes type 2 patiënten.

Summary

Introduction
A growing amount of people plays videogames. Not only children but also adults, both men and women. Videogames are not only played for fun but also for serious purposes. Games with another purpose then sole entertainment are called serious games. Serious games are applied in several areas, like in business world, government and health care. This research is focused on serious games in health care that aim for health related behavior change.

The main objective of this research is to determine the requirements and functionalities that a serious game must meet that aims for changing eating habits and sedentary lifestyle of adults with (a high risk for) type 2 diabetes in order to be useful and appealing for adults to play.

In this research the emphasis is on type 2 diabetes because figures show that the amount of people that develop type 2 diabetes is growing. Main cause for developing type 2 diabetes is overweight. A healthy lifestyle, which includes healthy eating habits and sufficient physical activity, can prevent or reduce the chance on developing type 2 diabetes. However, it is difficult for people to change and maintain a healthy lifestyle.

Existing interventions have shown insufficient outcomes and are most of the time not appealing to men. This indicates that another approach is needed that is also appealing to men. Figures of the Entertainment Software Association have shown that playing video games are appealing to men and women. Additionally, research has shown that serious games can stimulate adherence to a healthy lifestyle, because serious games are easy to personalize and provide a safe, interactive and engaging environment to experiment.

This research is sponsored by Medicinfo. Medicinfo is a healthcare innovation company.

Research approach
The research model that is designed for this research is based on an user-centered design. This means that the requirements and functionalities are determined based on the needs of the potential users. The research design consists of two stages. Stage 1 consists of an exploration of the field. Stage 2 consists of the identification of the needs of the potential users.

Based on the literature it is decided to take into account the differences in needs related to age, gender and voluntariness. Voluntariness refers to whether the serious game is used in a voluntary context or mandatory context.

For the data gathering mixed methods are used, because different types of data needed to be gathered and different target groups needed to be approached. In the first stage a literature review and survey are done. In the second stage structured interviews, a focus group and open interviews with experts are conducted. Based on the needs, the requirements and functionalities that the serious game must meet are determined.

Main conclusions
The results of the literature review have shown that there are little serious games that aim for health related behavior change that are for adults. Consequently, there was little known about the needs of adults related to such a game. With this research a first step is made to gain insight into those needs.

Especially men agree that a serious game can be supportive in changing lifestyle. This does not mean that they would like to use it, because a smaller amount indicate that they would like to use it. Still, more than half of the male respondents would like to use it.

A smaller amount of women agree that a serious game can be supportive in changing lifestyle. Approximately the same amount of women would like to use it. This suggests that perceived usefulness is a stronger predictor for the intention to use the game for women than for men.

This was in disagreement with the literature. However

The results of the structured interviews have shown that young adults (age between 20 and 25 years old) a serious game indicate as a means to relax. The main requirements and functionalities that the game must meet according to this group are:

- Interaction. By providing a two player option.
- Challenge/competition. By building up reaction time.
- Motivation. By a real person that gives advice.
- Tailoring and goal setting. By entering personal data and choosing recipes.
- Feedback. After and during the game/training.

- Action by doing. By Intense physical activity.
- Modeling. By being visible on the screen or creating a character.
- The game environment needs to be realistic with a moderate degree of detail.

The focus group was conducted among type 2 diabetes patients (age between 63-72 years). The results have shown that it is important to this group that the game is useful, because the participants stressed the need for information. The main requirements and functionalities that the game must meet according to this group are:
- Providing information. Written, uniform, tailored and provided in small amounts at the time
- Decision making. Choosing between multiple options.
- Rewards. Adjusted to difficulty level.
- Motivation. By guidance of a virtual coach.
- Tailoring and goal setting. Based on personal data.
- Feedback. After and during the game/training.
- The game environment needs to be realistic with a high degree of detail.

The results of the expert interviews show that overall the experts think that a serious game can have an added value for the type 2 diabetes patients.
However, they doubt whether type 2 diabetes patients would use a serious game to support them in changing their lifestyle. Therefore, the experts recommend to incorporate the game in the treatment program. When a game will be developed it should:
- represent a realistic environment that enhances moderately intense physical activity;
- provide general information about healthy eating habits

According to the game development process it is important to develop a prototype and test whether the target group will play the game out of intrinsic motivation by giving the game back to their homes. Or to integrate the game in a treatment program. Finally, it is important to emphasis in the game the positive effects of something that is difficult to do and to maintain.

Discussion
The main point for discussion is that it was not possible to test all the aspects related to the requirements and functionalities. For example, the combination of requirements and functionalities could not be tested, because a prototype is needed. Furthermore, the sample sizes were relatively small. This was a limitation of the methods that were used. However, the mixed methods made it possible to gather different types of data and to approach different target groups. This led to a complete overview of the requirements and functionalities that the serious game must meet according to the different target groups.

Recommendations
Based on the results the following recommendations are formulated:
- Conduct a thorough needs assessment before developing the first prototype.
- Determine budget and time before starting the development process.
- Start with implementing and evaluating the core requirements.
- Involve the potential users and stakeholders during the development process
- Develop two prototypes, one focused on young adults and one focused on type 2 diabetes patients.

Index

1 Introduction

The title of this thesis might indicate a few contradictions. It is, for example, not usual to link the words 'serious' and 'game'. The word 'serious' does not sounds like fun, while playing a game does. In addition, it is not usual to link the words 'adults' and 'games'. In general people link playing games, especially videogames, with children. Despite the unusualness of linking these terms, studies claim that games can be applied in order to serve a useful purpose other than sole entertainment (Prensky, 2003; Kranenburg, Slot, Staal, Leurdijk, & Burgmeijer, 2006; Zyda, 2005). Furthermore, figures reveal that the idea that gaming is only for children or adolescents is obsolete. According to the Entertainment Software Association (ESA) (2009) in the U.S. the average game player is 35 years old and 60 percent of all game players are men. In 2009 25 percent of the Americans over the age of 50 play video games, an increase from 9 percent compared to 1999.

Several definitions for the concept serious game exist. Table 1 gives a short list of definitions used by experts. Most of the definitions show resemblances with each other and agree that a serious game fulfills other purposes than sole entertainment. The main difference between these definitions is the emphasis on the entertainment element. In some of the definitions entertainment is explicitly mentioned as main objective. Other definitions emphasize that entertainment is subordinate to other purposes.

Table 1: Definitions serious games	
Definition	**Defined by**
Any *computerized* game whose *chief* mission is not entertainment, including entertainment games which can be reapplied to a different mission other than entertainment.	Saywer (in: Te Velde, Brennenraedts, Kaashoek and Segers, 2007, p.12)
A serious game has a goal different than entertainment alone, is based on ICT, and has a play element.	Kranenburg et al. (2006)
Games that do not have entertainment, enjoyment, or fun as their primary purpose.	Michael and Chen (in: Susi, Johannesson & Backlund, 2007)
A serious game is a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives.	Zyda (2005), p.26
Serious games differ fundamentally from their entertainment counterparts in that the applications have been designed with a specific meaningful purpose in mind.	Harteveld, Guimarães Mayer, Bidarra (2009)

In this research a serious game is defined as:

A game that is developed with as purpose to change health related behavior that uses entertainment to enhance this purpose

This definition is formulated as such because it shows a balance between a meaningful purpose and entertainment.

1.1 Serious games in health care

Kranenburg et al. (2006) believe that serious games can be broadly applied in health care considering the large amount of potential users and the application possibilities.

Table 2 shows the different types of serious games that are used in health care and their application areas.

Table 2: Serious games in health care	
Type game	**Application area**
Physical fitness "exergaming"	- Promoting healthy habits by adding the engaging elements of video games to physical activities.
Education in health/self directed care	- Teaching children nutrition skills and healthy eating habits, and how exercising can improve life. - Adjusting habits and lifestyle to deal with disease. - Motivate and educate young patients to fight disease and enhance self-management.
Distraction therapy	- Pain relief.
Recovery and rehabilitation	- Fasten recovery for certain operations and conditions. - Increasing motor skills.
Training and simulation	- Surgical training (e.g., training operating skills).
Diagnoses and treatment of mental illness/metal conditions	- Improving focus of children with ADHD - Diagnosing and treating patients with post-traumatic stress.
Cognitive functioning	- Memory training. - Developing analytical and strategic games.
Control games	- Teaching better control of mental and emotional states (e.g., games with biofeedback equipment. For instance, sensors that measure heart rate and skin conductance).

This table indicates that serious games can be useful in several areas of health care. Additionally, research has shown that serious games can have a surplus value in health care, because games differ from other interventions in their visual, textual, and auditory channels for feedback, games are engaging, games are easy to personalize by the user, games provide a safe environment to experiment without consequences for the user in real life, and because games can achieve some essential health objectives, e.g. compliance with the treatment (Watters et al., 2006). This makes the learning environment fun and without risks.

This research focuses on the possibilities for a serious game for people with (a high risk for) type 2 diabetes mellitus (from here: type 2 diabetes) that enhances a healthy lifestyle. Consequently, this research falls within the application areas: adjusting habits and lifestyle to deal with disease, teaching healthy eating habits and how exercising can improve life, promoting healthy habits by adding the engaging elements of video games to physical activities, and enhancing self-management. The next section elaborates on the relevance of a serious game as an intervention for people with (a high risk for) type 2 diabetes.

1.2 Relevance of a new approach to reduce type 2 diabetes

1.2.1 Prevalence type 2 diabetes

In 2008 the prevalence of diabetes in the Netherlands was 7,3 percent of the population. This was 3,7 percent in 2003. In Europe the growth of people with type 2 diabetes is increasing faster than expected. In 16 countries in the European Union more than 9 percent of the population is diabetic. In Germany 11,8 percent of the population is diabetic. This is the highest percentage in the European Union (Diabetes Vereniging Nederland (a), 2008). The prevalence of type 2 diabetes in America is approximately 8 percent of the population (Burnet et al., 2005).

Type 2 diabetes is a chronic metabolic disease whereby the pancreas produces not enough insulin or there is an impairment in the sensitivity of the body for insulin (Diabetes Vereniging (b), 2008). The main reason for the growing amount of people with type 2 diabetes is overweight. Figure 1 shows the amount of people with moderate overweight in the Netherlands and Figure 2 shows the amount of people with severe overweight in the Netherlands (RIVM (a), 2009).
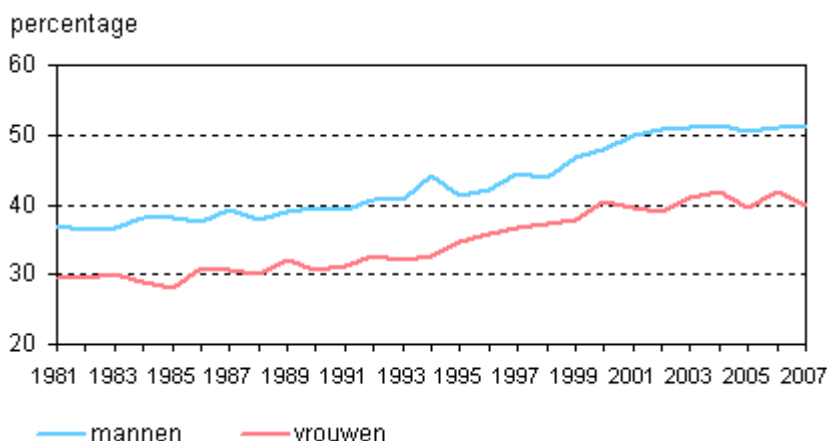
Figure 1: Percentage people (20 year and older) with mediocre to severe overweight in the period 1981-2007 (Source: RIVM (a), 2009).
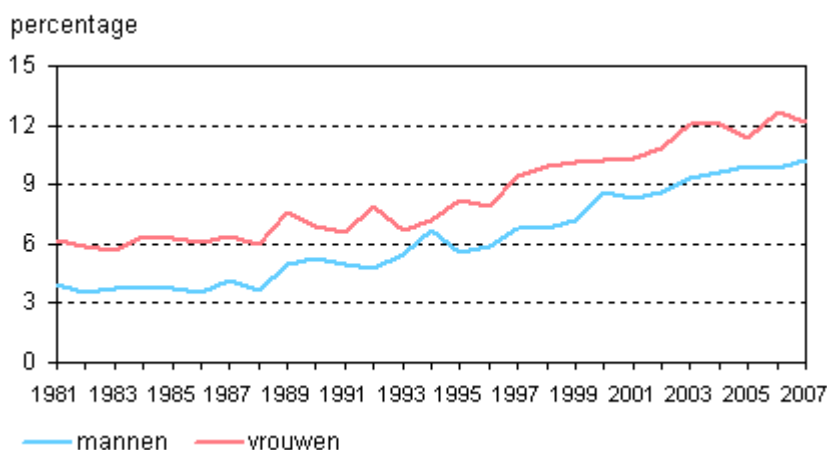
Figure 2: Percentage people (20 year and older) with severe overweight (obesity) in the period 1981-2007, (Source: RIVM (a) , 2009).

When this trend continues, the percentage of adults with severe overweight will increase with 50% within 20 years (RIVM (b), 2009).

Without overweight the percentage of men with type 2 diabetes will decrease with 53% and the percentage of women with type 2 diabetes will decrease with 26% (RIVM (b), 2009).

Despite that Figure 2 indicates that more females suffer from severe overweight, Table 3 indicates that more males suffer from type 2 diabetes.

Table 3 also indicates that younger people develop type 2 diabetes. This is alarming, because type 2 diabetes is actually a disease that occurs among the elderly. Overweight increases not only the risk of

developing type 2 diabetes but also risks to other diseases, like cardiovascular diseases, cancer, and infertility.

Table 3: Year prevalence (per 1.000) of type 2 diabetes; standardized by population of the Netherlands in 2007 (RIVM (c), 2009)		
Age group	Men	Women
0-14	0	0.3
15-24	0.7	0
25-44	6.4	6.0
45-64	68.0	47.6
65-74	171.4	140.4
75+	170.7	165.3

These figures and tables show that overweight is an increasing problem for public health and that incredible health gains can be achieved by reducing overweight.

1.2.2 Existing intervention are insufficient

There are several interventions that aim to enhance healthy eating habits and physical activity. However, studies have shown contradictory results. For example, outcomes of a mass-media intervention have shown that the intervention had little impact on physical activity behavior and to be effective in the short-term (Marcus, Owen, Forsyth, Cavill & Fridinger, 1998). While the outcomes of another study have shown significant effects on changes in dietary behavior and physical activity (Miles, Rapoport, Wardle, Afuape & Duman, 2001). Furthermore, Miles et al. (2001) report that there is little convincing evidence that campaigns can stimulate health behavior change.

Another type of intervention is face-to-face counseling by a professional. Main difference with mass media interventions is the degree of interaction, which is one-sided in mass-media interventions and two sided in face-to-face counseling. Research has shown that face-to-face counseling is effective in promoting physical activity (Elley, Kerse, Arrol & Robinson, 2003). Although, Eden, Orleans, Mulrow, Pender & Teutsch (2002) have shown that this is only in specific situations. However, face-to-face counseling is a time and cost consuming intervention and it reaches small numbers of people.

Computer-based and Internet-based interventions are less time and cost consuming interventions and can reach large numbers of people. Computer-based and Internet-based interventions are based on interaction with a computer. In the case of Internet-based interventions there is a connection with the Internet. Research has shown that computer-based interventions can be effective in enhancing healthy eating habits and physical activity, but that they mainly interest women (Anderson, Winett, Wojcik, Winett, & Bowden, 2001).

Examples of Internet-based interventions are self-tests, e-therapy with a virtual coach, and multimodal interventions (a combination of Internet-based methods). Research has shown that self-tests appear to be an effective intervention for increasing physical activity when the participants use the service with sufficient regularity (McKay, King, Eakin, Seeley & Glasgow, 2001). Other research in the field of self-test nutrition interventions showed to be effective for the short-term (Oenema, Brug & Lechner, 2001; Oenema, Tan & Brug, 2005). Research about e-therapy with a virtual coach and multimodal interventions indicated to be useful interventions for promoting a healthy lifestyle (Creed, 2006; Kristal, Curry, Shattuck, Feng & Li, 2000). However, Internet-based interventions also interest mainly women.

Based on this information it can be said that computer-based and Internet-based interventions are effective interventions to reduce overweight when they are used regularly. But the problem is that people find it hard to adhere to such an intervention. Additionally, these interventions are mainly appealing to women. This means that the existing interventions are insufficient to reduce overweight and an additional approach is needed that enhances adherence to a healthy lifestyle that is also appealing to men.

Because games are appealing to men and women (based on the figures of the ESA) and can enhance adherence to a healthy lifestyle it is assumed that a serious game might be a possible approach to reduce overweight.

1.3 Research objective and question

1.3.1 Objective

The main objective of this research is to determine the requirements and functionalities a serious game that aims to change eating habits and sedentary lifestyle of adults with (a high risk for) type 2 diabetes must meet in order to be useful and appealing for adults to play.

1.3.2 Research question

This report aims to answer the following research question:

What requirements and functionalities must a serious game meet that aims to change eating habits and sedentary lifestyle of adults with(a high risk for) type 2 diabetes?

1.3.3 Approach to answer the research question

Based on the philosophy formulated by Harteveld, Guimarães, Mayer, & Bidarra (2009) sub questions are formulated in order to answer the main research question. In order to answer the sub questions the research is divided into two stages. The first stage of the research consists of a literature review to explore the field of serious gaming in health care and a survey to test whether adults are interested in a serious game that aims to change eating habits and sedentary lifestyle. Also was tested with the survey whether there are differences in opinions of men and women.

The second part of the research consists of the identification of the needs of young adults and type 2 diabetes patients regarding to the serious game. The needs of the young adults were identified by using structured interviews. The needs of the type 2 diabetes patients were identified by conducting a focus group. Based on the needs could the requirements and functions that the games must meet be determined.

At last, interviews were conducted among experts related to the field of diabetes and game development to gain insight into their opinion about a serious game that aims for changing eating habits and sedentary lifestyle and the requirements that are needed.

This approach resulted in an extensive overview of the requirements and functionalities that the serious game must according to the different target groups.

1.4 Medicinfo

This research is sponsored by Medicinfo. Medicinfo is a healthcare innovation company that is founded in 2001 and is based in Tilburg. Through health portals (websites), a medical call centre and disease management programs consumers and health professionals are provided with information and services in the field of health, well being and lifestyle[1].

Medicinfo participates in the Centre for eHealth Research of the University of Twente, offering master and PhD students an opportunity to gain practical research experience in the field of eHealth. Simultaneously, Medicinfo profits from these research results to validate and improve her products and services.

The Diabetescoach research project (Nijland et. al., 2009) demonstrated the importance of attractive and easy to use lifestyle intervention programs to support diabetes disease management. Serious games may be useful in achieving lifestyle improvement in an attractive and entertaining way. Therefore Medicinfo requested this research, to analyse the possibilities and requirements of serious games to support people with (a high risk for) type 2 diabetes to change their lifestyle.

1.5 Reading guide

This research is based on the philosophy of Harteveld et al. (2009). In the following Chapter this philosophy will be elaborated and discussed. This Chapter also explains how the philosophy is used during this research. In chapter 3 the research model, methods and research instruments that are used for this research will be explained. The outcomes of the literature review are elaborated in Chapter 4. In Chapter 5 the results of the survey are listed and chapter 6 shows the results of the structured interviews and focus group. Subsequently the results of the interviews with the experts are elaborated in Chapter 7. Followed by the conclusions and discussion in Chapter 8. Finally, in Chapter 9 the recommendations are formulated.

---

[1] For more information, see www.medicinfo.info.

2 The game design process

2.1 The design philosophy

Harteveld et al. (2009) state that there is a lack of a proper and comprehensive design theory for serious games. With their study they want to contribute to the development of such a theory by explaining the underlying design philosophy of their game Levee Patrollers[2]. This philosophy specifies three conditions that are equally important in the design of a serious game: *play, meaning and reality*.

The play component includes: 1) the technology behind the games, such as artificial intelligence and computer graphics: 2) game elements such as rules, challenges, competition and: 3) the criteria for developing good games: fun, engagement and immersion. This component is most important to entertainment in games and is grounded in fields such as computer science, human computer interaction and game design.

The meaning component integrates aspects such as communication and learning. The meaning component is expressed in a serious game by persecuting certain learning goals or skills. To guarantee that knowledge is acquired or a specific message is received, theories derived from psychology and learning sciences can be used. Important criteria for this component are reflection, transfer and relevance.

The third component, reality, concerns the real world and how this world is represented in the game. The most important criteria for this component are fidelity, realism and validity.

In the next section the components will be elaborated.

2.2 Applying the design philosophy

To apply this philosophy it is important to understand what the components include and how they can be implemented in a serious game. In order to do so more information is needed about the elements of which the components exist and the criteria they must meet.

Firstly, the elements of the play component will be discussed. The focus will be on game design elements and the criteria: fun, engagement and immersion. The technology behind the game is at this moment of the design process of less importance, because this depends on several factors, such as the game genre, hardware on which the game will be played, budget and time. Also, Bates (2004) states that a good game depends on the gameplay[3] and not on special effects. For example, a game with mediocre graphics but great gameplay can still become a big hit (Bates, 2004). Therefore the focus is mainly on game design elements and the game criteria and less on the technology behind the game. Subsequently, the meaning component and the reality component will be discussed. The focus will be on all criteria that are mentioned by Harteveld et al. (2009).

2.2.1 The play component

In this section the elements of the *play component* will be discussed. Firstly, the game elements will be determined by deducting them from definitions of games defined by experts. Secondly, the relation between these elements and the criteria: fun, engagement and immersion will be discussed.

The definitions that are used in order to deduct the elements that characterizes a game are summarized in Table 4.

---

[2] Levee Patrollers is a game that is developed with the aim to train levee patrollers to recognize failures and to communicate their findings to the central field office.
[3] Gameplay is all the activities and strategies game designers employ to get and keep the player engaged and motivated to complete each level and an entire game (Prensky, 2002).

Table 4: Definitions games	
Definition	**Defined by**
Games have four fundamental elements in common, representation, interaction, conflict and safety.	Crawford (1982)
A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome	Salen and Zimmerman (2004)
Games are situated, competitive, interactive (learning-) environments based upon a set of rules and/or an underlying model in which, under certain constraints and uncertain circumstances, a challenging goal has to be reached.	Leemkuil (2006)
A form of art in which participants, called players, make decisions in order to manage resources through game tokens in the pursuit of a goal	Costikyan (2008)

The game elements that can be deducted from these definitions are interaction, decision making/conflict, challenge, uncertainty, competition, story, safety, rewards, and rules and constraints. These game elements can be implemented in different ways. The way in which these game elements are implemented is related to the degree of fun, engagement and immersion that is experienced by the player. In Table 5 is summarized how these elements are related to fun, engagement and immersion.

Table 5: Game elements and good game criteria			
	Fun	**Engagement**	**Immersion**
Game elements			
Interaction	• Two player option or against the system. • Actions and reactions lead to changes in the game situation.	• The player needs to constantly react on the changing environment in order to achieve goals.	• The player is actively involved in the game (Crawford, 1982).
Decision making	• Gives a sense of control.	• Leads directly to outcomes that indicate whether goals are achieved.	• A constant stream of interesting choices lead to a moment-to-moment experience (Bates, 2004).
Challenge	• Players get a boost when they achieve challenging goals.	• Allow the individual to perceive goal-feedback discrepancies (Leemkuil, 2006).	• Variation in challenging goals will draw the player into the game.
Uncertainty	• It is fun when it is uncertain whether the goals can be reached. • Uncertainty urges players to take certain risks. This is exciting.	• Not all information is available from the beginning.	• Unpredictability of the actions of others. • Unexpected events that are introduced in the game.

Table 5: Continued			
Competition	• Beating the system or others. • Demonstrating prowess.	• The player will play until he has beaten the other. • When the player looses he will come back to try it again.	• A competition will improve the moment-to-moment experience.
Story	• Creates a fantasy world.		• Draws the player into another world.
Safety	• Safe way to experience reality or situations that are not social acceptable.		
Rules and constraints	• Rules allow for a wide range of permissible actions to keep players motivated.	• Additional constraints may be introduced by implementing resources/incentives that can be won or loosed.	
Rewards	• Indicate that the player has achieved a difficult goal. A reward is a notification of success and leads to personal confirmation.	• Gives the player a secure feeling that he is doing well and motivates him to go on.	

Thus far it can be said that the game elements are an important aspect of the play component and that these game elements influence the degree of fun, engagement and immersion that is experienced by the player. Yet, it is not clear how the game elements can be applied. The fact that the game elements influence the fun, engagement and immersion experience of the player, indicates that this depends on what the player thinks is fun, engaging and immersive.

The game elements are expressed by the functionalities that a game includes. For example, the two player functionality expresses the game element interaction. However, interaction can be expressed in several ways. This means that it is essential to determine the functionalities that are preferred by the potential players of the game.

2.2.2 The meaning component

The meaning component integrates aspects like communication and learning. Important criteria that are related to communication and learning are reflection, relevance and transfer. Harteveld et al. (2009) did not explicitly mention these criteria in their study, but tried to explain them by describing the most important dilemma's that occurred during the development of Levee Patroller.

Reflection
According to Egenfeldt-Nielsen (2005) is reflection a critical aspect of the learning process. It is therefore important that the actions and decisions that are made in the game will be reflected. Harteveld et al. (2009) suggest that reflection can be incorporated in the game in two ways:
- Reflection after the action. This can be achieved by a thorough debriefing.
- Reflection during action. This can be achieved by pausing the game or by asking the player about the severity of the mistake he made.

Reflection during the action is more difficult to achieve. It has also consequences for the game experience, because the game needs to be interrupted. This negatively affects the immersion of the player in the game. This leads to a conflict between the meaning component and the play component. A trade-off needs to be made between the two components in order to achieve a balance between the components. Harteveld et al. (2009) calls this the "reflection dilemma".

Relevance
Harteveld et al. (2009) indicate that relevance is an important criteria for the meaning component, but does not mention more about this criteria. Egenfeldt-Nielsen (2005) states that relevance leads to the player's investment in the learning activity. He also found that it is important that the relevance is also perceived as such by the player. Without the recognition of the relevance by the player, the player will click the game away. This makes it important to understand what the potential user thinks is relevant and therefore it is crucial to involve the potential user in the design process.
The game developer does not always has all information and is not always capable to determine what is relevant and what is not (Egenfeldt-Nielsen, 2005). Therefore it is again important to involve the potential users, but also experts in the field.

Transfer
Transfer refers to how a message is sent to the player and how it is received by the player. Harteveld et al. (2009) mention when determining the message that needs to be transferred it may turn out that the game has multiple learning goals. It could be that there is an incongruence between some learning goals and the message to be transferred or some learning goals are conflicting with each other. In this case it is necessary to prioritize the learning goals. Harteveld (2009) calls this the "message dilemma".
Egenfeldt-Nielsen (2005) adds that transfer does not just happen, but that it has to be facilitated by the context surrounding the computer game experience. In other words it is not enough to simply learn the facts and knowledge on a given topic. The knowledge needs also to be applied in the lives of the players. Therefore Egenfeldt-Nielsen (2005) states that it is necessary that the player integrates knowledge into existing structures. This makes it easier for the player to transfer knowledge between contexts.
Bransford et al. (in: Egenfeldt-Nielsen, 2005) state that it is important that the players are aware of the learning elements, otherwise the transfer will be undermined.

In summary the meaning component is expressed in a serious game by persecuting certain learning goals or skills. To guarantee that these goals or skills will be met theories derived from psychology and learning sciences can be used. This research focuses on a serious games that aims to change behavior. This means to guarantee behavior change it is essential to base the game on a behavior change theory. In addition, it is necessary to determine what methods are suitable to enhance behavior change. This is related to the transfer criterion mentioned by Harteveld et al. (2009).
At the same time, it is essential to understand what is relevant information for the potential users and at what moment it is best to reflect on the aspects that are learnt during the game.

2.2.3 The reality component
The reality component refers to the representation of the real world in the game. Nowadays computer games can look very realistic, but it is unknown how detailed the game environment needs to be in order to be experienced as realistic (Harteveld et al., 2009). A great degree of detail in the game can distract the player from the real world. While, as mentioned before, it is important that the player can transfer the knowledge learned in the game across contexts. On the other hand, detail ensures recognition of objects or situations. Harteveld et al. (2009) call this problem the "detail dilemma". The amount of detail that is needed corresponds closely to the criteria of fidelity, realism, and validity. For example, the representation of the real world in a game may miss important aspects or misrepresent aspects. When an important element is missing, the player may experience the game as invalid (Harteveld, 2009; Egenfeldt-Nielsen, 2005). The amount of detail in representing the world in the game influences whether the player interprets the game as realistic, truthful and valid.
Harteveld et al. (2009) solved this 'detail dilemma' by using the comments and suggestions of experts and the levee patrollers themselves.

Based on the reality component it can be said that the game environment needs to be realistic. In order to design a realistic game environment it is useful to understand the degree of detail that is necessary to represent the world, otherwise the player can experience the game environment as invalid and untruthful.

2.3 Balancing the components

Harteveld et al. (2009) experienced that all three components are equal important by designing a serious game. Therefore it is important to balance these three components (Harteveld et al., 2009). That is rather difficult because of conflicting elements within and between the components which makes it necessary to make trade-offs.

These conflicting elements cause various tensions within and between the components. Harteveld et al. (2009) categorized these tensions as follows:

1. Within-component dilemmas, these dilemmas concern a choice between two alternatives that seem equally desirable or undesirable, which is restricted to one of the components.
2. Between-component dilemmas concern dilemmas between two components. These dilemmas can be caused by two components that have different perspectives on how to design a good game.
3. Trilemmas occur when there is a tension between all three components.

In this research the requirements and functionalities that are needed for a serious game that aims to change eating habits and a sedentary lifestyle will be determined. It is possible that tensions arise between the requirements resulting from this research. Therefore it is important to be aware of these tensions. A decision concerning one requirement can have consequences within a component or between components.

2.4 Adoption of serious games

It should be noted that the main goal of Levee Patrollers is to train levee patrollers to recognize failures and to communicate their findings to the central field office (Harteveld et al., 2009). The game is designed to increase the task performance of the levee patrollers. While, in this research the serious game is seen as a possible intervention to reduce overweight because it adds a fun aspect that can enhance treatment adherence. This shows that there is a difference in orientations of the games. Levee Patroller is more productive oriented, while the potential serious game in this research is more pleasure oriented.

According to Van der Heijden (2004) factors that predict user acceptance for information systems that are *pleasure oriented* (also called hedonic information systems) are different from the factors that predict information systems that are *productive-oriented* (also called utilitarian information systems). Hedonic systems aim to provide self-fulfilling value to the user and are strongly connected to home and leisure activities (Van der Heijden, 2004). Hedonic systems encourage prolonged rather than productive use. The factors that predict behavioral intention to use a hedonic system are perceived enjoyment and perceived ease of use. While for utilitarian information systems perceived usefulness is a strong predictor.

A serious game combines achieving an useful purpose with fun. This suggests that in general a serious game has an utilitarian character as well as a hedonic character. This indicates that for a serious game perceived ease of use, perceived enjoyment (comparable with the play component) and perceived usefulness (comparable with the meaning component) are equally important. This is comparable to the philosophy of Harteveld et al. (2009).

It should also be noticed that Harteveld et al. (2009) involved the potential user in the design process in order to understand the needs of the potential user and how these needs could be translated into requirements and functions for the game. According to Sun & Zhang (2005) there are differences in factors that predict behavioral intention to use an information system between gender and age. Sun & Zhang (2005) state that perceived usefulness has a stronger effect on behavioral intention for men than for women. In addition, perceived usefulness has a stronger effect on behavioral intention for younger users than for older users. This suggests that it is important to take these differences into account when involving the potential user.

Finally, Levee Patrollers was designed be used during workshops. This means that the context in which the game was used, was rather mandatory because it was not possible to participate without using the game. Sun & Zhang (2005) suggest that the influence on behavioral intention to use an information system is stronger in mandatory contexts than in voluntary contexts. However, Aganval & Prasad (1997) showed that initial usage of a system may be influenced by perceptions of voluntariness, but that people will continue to use the system only if they find the system useful.

This means when developing a successful serious game that aims to change eating habits and sedentary lifestyle it is not only important to balance the three components, but also to take into account the differences in needs related to gender, age and voluntariness. Based on the philosophy of

Harteveld et al. (2009) and this discussion the following model can be formulated for the design of a successful serious game:


```
MODERATING FACTORS

    GENDER

    AGE

    VOLUNTARINESS
```

USER NEEDS

THE PLAY COMPONENT

- Game elements
  - Interaction
  - Decision making
  - Challenge
  - Uncertainty
  - Competition
  - Story
  - Safety
  - Rules and constraints
  - Rewards

THE MEANING COMPONENT

- Theoretical background
- Behavior change methods
- Information
- Reflection

THE REALITY COMPONENT

- Degree of detail in representing the world

SUCCESSFUL SERIOUS GAME

BEHAVIOR CHANGE

Figure 3: A model for serious game design

The model shows that the implementation of the components depend on the user-needs, which are influenced by gender, age and voluntariness. In addition, the components influence each other, because they need to be balanced. When implementing the components based on the user-needs with taken into account the moderating factors will lead to a successful serious game that will be used by the potential user. A successful serious games means a game that achieves it purpose, in this case behavior change.

2.5 Conclusion
For this research the philosophy of Harteveld et al. (2009) was used as basis to determine the requirements and functionalities that are needed for a serious game that aims to change eating habits and sedentary lifestyle of adults with (a high risk for) type 2 diabetes. This meant that it was crucial to determine how the three components play, meaning and reality need to be implemented in the game. In order to do so, the following sub questions need to be answered:

1) What health behavior theories underpins the serious games that are already used in health care in order to change health related behavior?
2) What behavior change methods are used in existing health related behavior change games and what are their effects related to:
   - health outcomes;
   - behavior outcomes.
3) How need the game elements to be applied in order to make the game fun to play for the adults with (high risk for) type 2 diabetes?
4) How need the change methods to be applied without decreasing the fun experience?
5) What information is relevant to include in the game?
6) How realistic and detailed needs the real world to be represented in the game?

During this research it was difficult to research how the game elements should be applied in order to achieve an engaging and immersive experience by the player. It was difficult to ask whether the player found something engaging without playing a game. Therefore, it was only possible to understand what requirements and functionalities are needed for the game in order to be fun. Regarding to the meaning component it was important to understand which behavior change theory and behavior change methods could be used in order the enhance behavior change.

In addition, it is important to balance these three components and it is possible that tensions appear. For example, change methods can decrease the fun experience. This means that not only the change methods needed to be determined, but also which methods appeared to be fun to the player.

Based on the findings of Sun & Zhang (2005) it was decided to take into account the differences in needs related to age, gender and voluntariness. The following chapter elaborates the research design and the methods that are used for this research.

3 Methodology
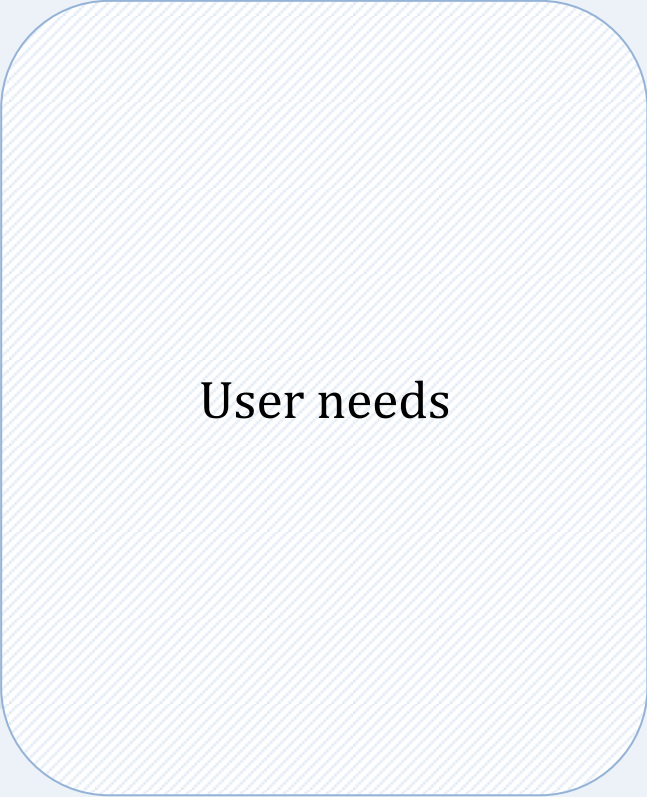
3.1 Research design

Baarda & de Goede (2006) describe three types of researches; descriptive, exploratory and testing. Babbie (2004) adds another type of research, namely explanatory research. Descriptive research mainly focuses on describing concepts and its measurements, exploratory research focuses on the development of new concepts, testing focuses on testing theory in practice and explanatory research explains causes of a phenomenon.

This research can be characterized as a descriptive research, because it describes the requirements and functionalities that are needed for a serious game that aims to change eating habits and sedentary lifestyle of adults with (a high risk for) type 2 diabetes.

Table 6 shows the aspects that need to be determined based on the sub questions that are formulated in Chapter 2 in order to determine the requirements and functionalities needed for the game.

Table 6: Aspects to be determined			
	Gender	**Age**	**Voluntariness**
Play Game elements: - Interaction - Decision making - Challenge - Uncertainty - Competition - Story - Safety - Rules and constraints - Rewards	User needs		
Meaning - Theoretical background - Behavior change methods - Information - Reflection			
Reality Representation - Degree of detail			

The research design that was used to for this research is based on a user-centered design.

A user-centered design (UCD) is *"a formal approach to ensure that new products address the needs, wants, skills, and preferences of the user throughout the tool's development. UCD is a design and evaluation process which pays special attention to the intended users, what they will do with the product, where they will use it, and what features they consider essential"* defined by Mauro & de Quirós, (in: Wilson, 2008, p.10). UCD is also known as patient-centered design or patient empowerment.

It was decided to apply an user-centered design, because Harteveld et al. (2009) have shown that dilemma's that occurred during the design process of Levee Patrollers were overcome by involving the potential users. In addition, studies about the design process of information systems have shown that an user-centered approach is more successful than a technology driven approach (Hesse & Schneiderman, 2007; Waller, Franklin, Pagliari & Greene, 2006). These studies have shown that user

involvement during the design process can overcome barriers related to both the technology and the acceptance of the technology.

The realization of an user-centered design differs from case to case (De Rouck, Jacobs & Leys, 2007; Skinner, Maley & Norman, 2006; Kinzie, Cohn, Julian & Knaus, 2002). The basic idea of an UCD is to involve the potential users and stakeholders during the design process in order to identify their needs. Based on the feedback given by the potential users the design can be modified in order to meet the needs. This increases the chance that the product will be successful and accepted by the users. The design that is applied for this research is presented in Figure 4.

Figure 4 shows that mixed methods are used for this research. It was decided to use mixed methods because of the differences in the data that needed to be gathered and because the needs of different targets groups needed to be identified. In the following sections the stages of this research design will be elaborated.

Exploration of the field
- Literature review
- Survey

Identifying needs potential users
- Structured interviews
- Focus group
- Interviews with experts
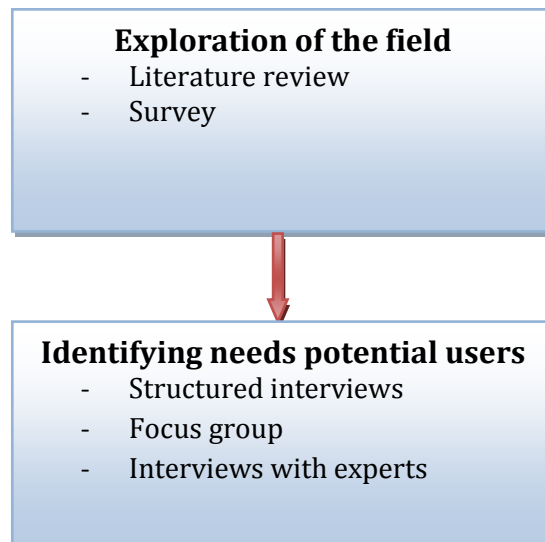
Figure 4: Research design

3.1.1 Primary exploration of the field

This research started with a literature review to gain insight into the research field of serious gaming in health care with a focus on how the game elements are applied (the functionalities) and which behavior change theories and methods were used as basis for the games. During the literature search it appeared that studies about serious games in health care that aimed to change health related behavior change were mainly focused on children. Hence, it was unclear whether serious games could be supportive for adults. Additionally, the literature review gave little information of the functionalities of the game elements.

The literature review gave an overview of the behavior change methods and showed that several methods have affected health and/or behavior change outcomes. However, it gave insufficient information about how the methods could be applied in a game for adults.

Based on these results further research was necessary in order to gain insight into whether adults in general are interested in a serious game and whether they agree that it could support them in changing lifestyle. A survey was particular useful for this purpose, because it made a relative large sample feasible and it was less time consuming than other research methods (Babbie, 2004). The large sample size made it also possible to identify differences between men and women.

Further research was also needed to identify the needs of the potential users.

3.1.2 Identifying needs potential users

Based on the research findings of Sun & Zhang (2005) and because a growing amount of younger people develop type 2 diabetes it was decided to involve type 2 diabetes patients (age between 40 to 80 years old) and young adults (age between 18 to 30 years old). It was assumed that there was a difference in experience between the age groups and therefore it was decided to gather in dept information among both groups with two different approaches. It was decided to conduct structured interviews among young adults and a focus group among type 2 diabetes patients.

The structured interviews were chosen because it was presumed that it was difficult for the respondents to tell ad hoc what their preferences are regarding games. Therefore a structured interview was formulated that included questions about the game elements and behavior change methods that were deducted from the literature review.

A focus group was chosen because focus groups:

- can provide information about the ways that people behave and the motivations that underlie these behaviors (Morgan, 1998);
- allow to unravel new important topics, that were not yet recognized by the researcher (Morgan, 1998);
- provide group dynamics in the room (Greenbaum, 2000; Morgan, 1998);
- directly involve the potential users in the research/design process which enhances the credibility of the conclusions at the end of the project and fosters a cooperative and constructive approach to results (Greenbaum, 2000);
- make it possible to generate a significant amount of very useful research information in a short period of time (Greenbaum, 2000).

Group dynamics was especially important, because in general most diabetes type 2 patients are older than 40 years old and it was assumed that this group did not have (sufficient) gaming experience. This could make it difficult for the participants to articulate their preferences. The interaction with the other participants and researcher made it possible to articulate preferences by hearing others talk about theirs.

This stage also includes interviews with experts. Because conducting interviews is rather time consuming it was decided to interview at least one nutritionist, one physiotherapists, and one game developer, to gain insight into their opinion about a serious game that aims for changing eating habits and sedentary lifestyle and the requirements that are needed.

The interviews with the nutritionist and physiotherapists were focused on relevant information for type 2 diabetes patients related to nutrition and physical activity. The interviews with the game developers were focused on the development of a prototype.

The interviews had an open character, because it was important to understand what the respondents indicated as relevant information that needs to be provided in the game. However, a questionnaire was formulated in case the conversation would not went naturally. The moderating factor voluntariness was also included as part of the interview questions.

3.2 Research instruments

To explore the field of serious games that aim to change health related behavior and to indentify the needs of the different target groups mixed methods were used. In this section the instruments that were used during the implementation of the methods will be discussed.

3.2.1 Literature search

The aim of the literature review is to gain insight into the theoretical backgrounds of existing games in health care, the functionalities of the game elements and behavior change methods and their effects on health and health behavior change outcomes.

The database Pubmed was used for the literature search starting with the key terms serious games and health and then expanded and varied with other terms depending whether they generated more results. An overview of the search is provided in Appendix A: Systematic PubMed search.

The first selection was based on publication year and language. The inclusion criteria were:

- Articles written after 2000[4]
- Only English or Dutch written articles

A second selection was made based on the title, abstract and the content of the article. Articles about games that stimulated healthy lifestyle (with a focus on diet change and/or physical activity) and reported outcomes related to health outcomes and/or behavioral change outcomes were included. Also articles on videogames that stimulated other health related behavior, for example adherence to treatment or self-management of chronic disease, were included.

---

[4] According to Egenfeldt-Nielsen (2007) the field of serious games emerged since 2000.

Articles about games for people that are disabled or people that have a mental disorder are excluded. In addition, interactive multimedia programs that are not games and games that are not videogames are excluded. The selections led to the inclusion of 14 articles. To ensure that no articles were missed, the references of the 14 articles are searched. The search was redone on August 8th 2009 to ensure that any recent articles would also be included. This led to the inclusion of two more relevant articles.

Out of the 16 articles that are included, one article was a meta-analysis of 27 articles. In total the articles researched 33 different serious games. The games found in this literature search can be divided into four categories: diet change games, physical activity change games, diet and physical change games, and other health behavior related games.

Analysis

The articles used for this report were studied on the following aspects:
- Game elements.
- Theoretical background.
- Behavior change methods.
- Effects related to behavior change and health outcomes.
- Information regarding to the study design.
- Data gathering methods.

3.2.2 Survey

The aim of this survey is to get a general idea about the interests of adults in a serious game as a tool for changing lifestyle and in what form they would like to have it.

The first part of the survey included five questions. Three questions regarding to age, gender and education. Followed by the two items 'how often do you play games' and 'what kind of games do you prefer most' which tested the gaming experience. The second part of the survey included ten statements. The items 'a computer game can be supportive in changing lifestyle' and 'I would like to use a computer game that aims to be supportive in changing lifestyle' tested whether the respondents are interested in a game that aims to be supportive in changing lifestyle.

The survey tested two items related to the reality component, namely the preferences of the respondents regarding to the representation, 'a computer game that aims to be supportive in changing lifestyle needs to look realistic' and 'a computer game that aims to be supportive in changing lifestyle needs to have high quality graphics'.

Related to the play component items 'a computer game that aims to be supportive in changing lifestyle needs to have a two or more player option' and 'a computer game that aims to be supportive in changing lifestyle needs to be played online' which tested how the game element interaction needs to be implemented. Three items tested whether the game needs to be tailored, informative and actively played: 'a computer game that aims to be supportive in changing lifestyle needs to be tailored in order to set personal goals', 'a computer game that aims to be supportive in changing lifestyle needs to be informative', 'a computer game that aims to be supportive in changing lifestyle needs to be played actively (like the Wii Fit). These items are related to the meaning component. The last item, 'a computer game that aims to be supportive in changing lifestyle needs to be provided on a mobile device (like a Gameboy or Nintendo DS, mobile phone), tested whether the game needs to be provided on a mobile device,

The respondents could answer on a 4-point scale: completely agree, agree, disagree and completely disagree. The reason for this 4-point scale is to prevent that people would give neutral answers because serious gaming in health care is a relative new field and probably the respondents knew too little about games and therefore would choose for the "safe" answer. The questionnaire used during the survey is included in Appendix B: Survey questionnaire.

Respondents

The survey is conducted among a random sample of 70 respondents age 18 and above, that had a clear understanding of the Dutch language. The respondents are recruited in the city centre of Enschede, in the train, in the supermarket, and via email to family and friends. The recruitment of respondents in the city centre and supermarket did not work.

Procedure

The survey was pre-tested among participants of a workshop about XNA organized by student association Inter-Actief[5] and Microsoft. XNA studio is a software package that is used to develop games. The participants of the workshop were asked to fill in the survey and to give comments about the content of the survey. The pre-test showed no errors in the questionnaire and according to the respondents no items had been forgotten. After pre-testing, the survey was handed-out in the city centre of Enschede, in the train, in the supermarket, and via email to family and friends. The moments to hand-out the surveys was taken into account, for example, as well as during working hours as outside working hours.

Before handing out the survey the goal and purpose of the research were explained to the respondents. It was also explained that the data would be processed anonymously. After this information the respondent could choose to fill in the survey or not.

Analysis

Data from the surveys are imported in the statistics program SPSS 16.0. The results from the survey are analyzed using conventional descriptive statistics. First, frequency tables are calculated. The Mann-Withney test is then used to determine whether there are significant differences between men and women. The Mann-Withney test determines whether two independent samples have the same mean (Huizing, 2004).

3.2.3 Structured interviews

The aim of the structured interviews is to gain insight into the preferences of young adults regarding to the game elements, behavior change methods, and game environment.

The interview consisted of two parts. In the first part, by means of nine examples of applications, the respondents were asked what their preferences are.

Table 7 presents the applications that are used during the interviews and shows which functions are tested. See Appendix C: *Questionnaire structured interview* for the questionnaire that is used during the interviews. The applications are selected based on their functions. When an application did not give additional results regarding its functionalities it was excluded from the interview. All applications enhanced adherence to a healthy lifestyle related to healthy eating and/or physical activity.

The game element story is excluded from the research because this element is closely related to the engagement of the player in the game. This was difficult to test without playing a game. Uncertainty and safety are excluded from the research because they are characteristics that are hard to manipulate.

The game element sense of control was added because during the selection of the applications it seemed an element that could influence the fun experience. All behavior change methods resulting from the literature review are included.

The second part consisted of five additional questions about, whether the game should involve diet change elements, physical activity change elements or both, the device on which the game needed to be provided, how the game environment should look like, how the character should look like and which actions the character should perform. The latter refers to the game element rules and constraints.

---

[5] Inter-Actief is a student association for students of Computer Sciences.

Table 7: Description and functions			
Name	**Description**	**Type**	**Functions**
Start to run	A series of downloads that includes running schedules accompanied by music and spoken instructions by a coach.	Physical activity	*Play* - Challenge: upgrading difficulty level. - Rewards: giving compliments. *Meaning* - Motivation: a coach (real person) gives directions via a mp3 player. - Information: providing advice during work-out about sport outfits, sport shoes, nutrition, preventing injuries.
Nike + Ipod	A small RFID device (sensor) that can be tied up on your shoe broadcasts workout data to a small receiver plugged into an iPod Nano.	Physical activity	*Meaning* - Tailoring: choosing personal work-out scheme based on work-out length, amount of calories to be burnt, distance. - Tailoring: choosing music during work-out. - Feedback: during work-out information is provided related to elapsed time, distance, and burnt calories. - Feedback: provides after training information about performance on a website. - Motivation: possibility to exchange information via website with other runners.
Gamebike	A hometrainer that is connected to a Playstation 2. The game is driven by pedaling as fast as the player can.	Exergame	*Play* - Interaction: two player option. - Sense of control: the player decides the speed of the game. *Meaning* - Action by doing: the physical activity during the game is intense. *Reality* -The game environment is realistic.
Lasersquash	Laser beams are fired and the player needs to hit them.	Exergame	*Play* -Challenge: building up reaction time (by firing laser beams faster). - Interaction: possibility to play with a group, because of short duration of the game. - Competition: keeping up high scores. - Challenge: the difficulty levels increases. - Reward: a bonus when reaction time is very high. *Reality* - The game environment is futuristic.

Table 7: continued				
Wii fit	A game console with a balance board that includes more 40 exercises that aim to improve the balance, position and Body Mass Index of the player.	Exergame	*Play* - Interaction: performing exercises together. - Sense of control: using a balance board. - Competition: challenging others. *Meaning* - Tailoring: register data about weight, height and other health related data in order to formulate personal goals. - Modeling: creating your own character. - Action by doing: the exercises include moderate physical activity. *Reality* - The game environment is realistic.	
Eye toy	A camera that is connected to a Playstation 2 or Playstation portable. The camera makes it possible to make the player visible in the game.	Exergame	*Play* -Interaction: playing the game together with others in real life. *Meaning* - Modeling: being visible in the game. *Reality* - The game environment is unrealistic.	
Nutrition Decision	Mini games that learn how to read nutrition labels, and to estimate serving sizes and moving more.	Education	*Play* - Interaction: playing the games without other players. - Decision making: multiple choice questions. *Meaning* - Information: getting information about nutrition labels. - Feedback/reflection: rehearsal of skills.	
Cooking guide	A virtual cook guides the player during the preparation of a recipe in real life.	Education	*Play* - Challenge: preparing recipes in real life. *Meaning* - Motivation: guidance of a virtual cook. - Information: asking for instruction films for more information. - Tailoring: choosing recipes based on difficulty, amount of calories, cooking methods and preparing time.	
Cooking mama	A game in which the player prepares recipes in a virtual environment	Education	*Play* - Challenge: preparing recipes in a virtual kitchen. - Interaction: exchanging recipes with others.	

Respondents

For the structured interviews students are recruited, because it was less time consuming to recruit them. The respondents are recruited via word of mouth. In addition, the participation was voluntary and rather time consuming, therefore it was decided to conducted the interviews among 5 respondents. The inclusion criteria were:

- Understanding of the Dutch language.
- The proportion 3 men and 2 women, because it was important that the serious game would be appealing to men, because more men develop type 2 diabetes than women.
- Age between 18-30 years old.

Process

Before starting the interviews the purpose of the research was explained. Subsequently, the respondents were asked for their consent for recording the interview.

The interview started with a description of the application. After the description the functionalities to be tested were summarized in a table. The respondents were asked to mark with a cross the functions they preferred. By asking which functions the respondents liked best provided a better understanding how the game elements and behavior change methods should be applied.

It should be noted that the respondents did not know whether a functionality was a game element or a behavior change method.

After they filled in the tables the respondents were asked to answer the five additional questions.

Analysis

All game elements and change methods were listed in separate tables. The outcomes regarding to the additional questions were first transcribed and then listed thematically.

3.2.4 Focus group

The aim of the focus group is to gain insight into the preferences of type 2 diabetes patients (age between 40-80 years) related to the game elements, behavior change methods, and game environment. During the focus group two questionnaires were used. The first questionnaire included eight examples of games. Of each game a description was given. The questions that were formulated tested the preferences of the respondents related to the game elements, behavior change methods and the representation. The questionnaire consisted of twenty three questions. The respondents could answer 21 questions on a 3-point scale: yes, no or I don't know. Two questions were multiple choice questions. See appendix D: Questionnaires focus group.

Table 8 summarizes the functionalities that are tested and the items that are used. The selection of the games for the focus group was comparable to the selection of the applications used for the structured interviews. However, it was important to test as much functionalities as possible and that fragments of the games were available. This meant that it was not possible to use the same applications as during the interviews, because not all applications provided fragments. Also, games are included that had a different focus than nutrition or physical activity, because these games included functionalities that may be preferred by the player.

The second questionnaire is focused on the background information of the respondents. The questionnaire included questions related to computer experience, gaming experience, expectations of a game that aims to change lifestyle, health and lifestyle, treatment and demographics. See appendix E for the questionnaire that was used.

Table 8: Game description and items			
Name	**Description**	**Type**	**Items**
The Great Flu	The player needs to prevent a pandemic By making strategic decisions	Strategy game	*Play:* - Decision making: do you like to make strategic decisions like in the Great Flu? - Decision making: do you like to make decisions under time pressure? *Meaning:* - Feedback: during the game The Great Flu you need to make decisions without seeing direct effects. Do you prefer this or would you rather see direct effect?

Table 8: Continued			
Quest for the Code	Mini games that learns aspects related to asthma	Education	*Play:* - Decision making: Would you like to learn more about nutrition and physical activity by answering questions that need to be slide to the right place? *Meaning:* - Information: would you like to have the possibility to ask for more information?
Nutrition Decision	Mini games that learn how to read nutrition labels, and to estimate serving sizes and moving more.	Education	*Meaning:* - Information: Do you like to play mini games? - Feedback/repletion: Do you like to rehearse skills?
Re-mission	Players pilot a nanobot named Roxxi as she travels through the bodies of fictional cancer patients destroying cancer cells, battling bacterial infections, and managing side effects associated with cancer and cancer treatment.	Adventure	*Meaning:* - Motivation: Do you like it to be accompanied by a virtual coach? - Problem solving: Do you find it important to solve problems in the game related to your disease? - Feedback: I would like to get feedback: • During the game by means of a virtual guide. • After the game by means of a virtual guide • Other, namely…… • I do not know *Reality:* - Do you find it important that the game takes place inside a human body?
Inno8	simulation game, gives both IT and business players a better understanding of how effective Business Process Management impacts an entire business system.	Strategy/simulation	*Meaning:* - Information: do you prefer getting information by text? - Feedback: do you prefer to see direct effect of your decisions in the game? -Feedback: do you like to see a film that explains the right answer? - Feedback: Do you like to get an overview of your performance at the end of a session?

Table 8: Continued			
Wii Fit	A game console with a balance board that includes more 40 exercises that aim to improve the balance, position and Body Mass Index of the player	Exergame	*Play:* - Interaction: do you like to play the game with others? *Meaning:* - Tailoring: would you like it to register your personal data in order to set personal goals -Motivation: would you like to compare your performance with the performance of others? - Feedback: would you like it to see whether the goals have come closer after each exercise?
Silverfit	Consists of several mini games that are driven by minimal physical activity.	Exergame	*Meaning:* - Information: do you like to play games that are not directly related to your disease, but that you are physical active which is good for your health? - Information: would you like to receive no information during the game about your health
Gamebike	A hometrainer that is connected to a Playstation 2. The game is driven by pedaling as fast as the player can.	Exergame	*Play:* - Competition: do you like to play the game against another player? *Meaning:* - Action by doing: which game do you prefer most: • Wii Fit • Silverfit • Game bike • I do not like to be physical active during the game

Respondents

A focus group usually consists of 6 to 8 participants (Miles & Gilbert, 2005), but Greenbaum (2000) states that it is also possible to conduct a focus group among 4 to 6 participants. According to Greenbaum (2000) there are no differences between small and large groups. It depends on the preference of the researcher whether to conduct a small or large focus group. During this research the recruitment of type 2 diabetes patients was rather difficult, therefore it was decided to conduct a focus group among 4 to 6 participants.

For the recruitment of participants various channels were used. Firstly, Trias[6] and Praktijkondersteuning Zuidoost Brabant (PoZoB)[7] were contacted. Medicinfo already had contact with these organizations. Both informed that they could not help with the recruitment of type 2 diabetes patients and PoZoB referred to the Diabetes Vereniging Nederland (DVN). DVN offered an

---

[6] Trias is a Dutch health insurance company. See http://www.trias.nl

[7] PoZoB is a partnership between general practitioners that is established for general practitioners. See http://www.pozob.nl

advertisement place in their newsletter, but they asked a financial compensation that did not suited the budget for this research. Subsequently, researchers in the field of diabetes research of the University Twente were asked for advice. They recommended to post a call up on the website: diabetesforum.nl. Unfortunately, the posting on the website did not yield participants for the focus group. Therefore, it was decided to approach Previtas. Previtas is a clinic for weight management and supports people in changing their lifestyle in order to lose weight. MedicInfo had also already contact with this organization. Additionally, it was decided to recruit participants among friends and family. The last two approaches yielded enough participants for the focus group.

Process
A few days before the focus group an email was sent to the respondents with information about the research. It was explained what MedicInfo does, what the aim of the research was and what was expected of the respondents during the focus group. Also practical information was given, like location, expected duration, and starting time.
At arrival it was again explained what the aim of the research was and what was expected of the respondents. It was stressed that the respondents could ask questions and that they could stop whenever they wanted.
Subsequently, it was asked whether the respondents had problems with recording the session. All respondents signed the informed consent. The respondents introduced themselves before the focus group started. During the focus group a research assistant made notes of the discussion.
The focus group started with handing out the first questionnaires. After handing out the questionnaire it was explained that the respondents would watch eight fragments of games. Before watching the game fragments a short description about the game was given. This description was also provided in the questionnaire. After watching each fragment the respondents filled in the corresponding questions. Subsequently, the questions were discussed. The questions were used to guide the discussion, but it was possible for the respondents to discuss other things they found important.
After discussing the fragments it was asked whether the respondent would like to discuss other topics related to the research. At the end of the focus group the second questionnaire was handed out that included questions related to computer experience, gaming experience, lifestyle, treatment and demographics. The respondents received a compensation for their participation.

Analysis
Firstly, a transcript was made of de recordings that were made during the focus group. Secondly, the results are listed thematically.

3.2.5 Interviews with experts

The aim of the interviews with experts is to gain insight into their opinion about a serious game that aims for changing eating habits and sedentary lifestyle and the requirements that are needed.
The interviews with experts had an open character. However, a (short) questionnaire was formulated as a back-up. See appendix F: Questionnaire open interviews.

Respondents
Firstly, Fysiotherapeuten Zuidoost Brabant (FyZoB)[8] was contacted, because they recently started a physical activity program for type 2 diabetes patients. The secretary responded. He was not a physiotherapist himself, but he was involved in the design process of the program. Therefore, also a physiotherapist was contacted. The physiotherapist that was contacted did a internship at Medicinfo in order to do her Master thesis Communication Studies.
For the nutrition aspect Thebe[9] was contacted. For the game design aspect the Technical University Delft was approached, because they were mentioned in a newspaper article about serious gaming.

Process
Before the interview started the purpose of this research was explained. Subsequently, consent was asked for recording the interview. After they gave their consent the interview started.

---

[8] FyZoB is a partnership between physiotherapists. See: http://www.fyzob.nl
[9] Thebe is a homecare organization located in Tilburg (the Netherlands) See: http://www.thebe.nl

Analysis
The records are transcribed and then the results are listed thematically.

3.3 Conclusion
The research model that was used for this research is based on a user-centered design. This model consists of two stages in which mixed methods were used for the data gathering. Mixed methods were used because different types of data were needed to be gathered and because the needs of different targets groups needed to be identified. The following chapters discuss the results of this research.

4 Research in the field of serious gaming in health care: A literature review

The aim of the literature review is to gain insight into the functionalities of the game elements and behavior change methods and their effects on health and health behavior change outcomes.

4.1 Results

In this section the results of the literature review will be elaborated. Appendix H: Literature overview shows an overview of the studies that are found during the literature search.

4.1.1 Game elements

Most of the reports provided little information about game elements. They also showed little interest whether the game was fun, engaging and immersive. Some studies vaguely mentioned that the game was fun to play or that one condition was preferred to another.

Only three studies explicitly mentioned the game elements (Thompson et al., 2007; Peng, 2009; Lieberman, 2001). One of these studies reported which elements were incorporated in order to make the game fun (Peng, 2009).

Three studies provided a description of the game and/or the story line for the game (Kato, Cole, Bradlyn & Pollock, 2005; Silverman, Holmes, Kimmel & Branas, 2002; Baranowski et al., 2003). This made it possible to deduct game elements from the descriptions and storylines. See for the storylines Appendix G: Storylines. The results are presented in Table 9.

Table 9: Game elements in literature					
Author(s)	**Game title**	**Game type**	**Game elements**	**Functionality**	**Target group**
Thompson et al. (2007)	• Escape from Diab • Nanoswarm	Diet& physical activity	1) Story/fantasy 2) Decision making (strategic)	1) Appendix G 2) Plan an escape plan (D). Choosing healthy food and activities (N)	Children
Peng (2009)	RightWay Café	Diet& physical activity	1) Story/fantasy 2) Competition and challenge 3) Decision making	1) Appendix G 2) Competitor in tv show. Player that can best manage his daily diet in a healthy way will win 3) Choosing breakfast, lunch, dinner, and snacks for his or her avatar/character in the game	Adolescents
Lieberman (2001)	• Packy & Marlon (P) • Bronkie the bronchosaurus (B)	Other health related behavior	1) Story/fantasy 2) Interaction 3) Decision making 4) Competition	1) Appendix G 2) With other players 3) Choosing appropriate amounts of insulin, choosing foods containing a good balance of food exchanges (P) Avoiding asthma triggers (B) 4) Not reported	Children/pre-adolescents
Kato et al. (2005)	Re-Mission	Other health related behavior	1) Story/fantasy 2) Decision-making	1) Appendix G 2) Strategic decisions related to self-management	Adolescents/ young adults
Silverman et al. (2002)	Heart Sense	Other health related behavior	1) Decision making	1) Regarding a potential myocardial infarction	Adults

Table 9: Continued					
Baranowski et al. (2003)	Squire's Quest	Diet	1)Story/fantasy 2)Challenging goals 3)Decision making 4)Rewards	1) Appendix G 2) Eating more fruit and vegetables 3) Choosing favorite fruits and vegetables 4) Getting points	Children

The results show that almost all games included a story and fantasy. It should be noted that all these games were focused on children or adolescents. One game which focused on adults did not include a story. This suggests that the inclusion of a story may not be important for a game that is focused on adults. However, Baranowski, Buday, Thompson & Baranowski (2008) state that the inclusion of a story and fantasy engages children *and* adults. Although, this depends on the content of the story. A story is effective when it reflects personal interests and concerns.

All games show a decision making element. Mainly, the decision element is focused on choices related to healthy food or managing the disease. The fact that all games that were studied show a decision making element indicates that this is an important element to include in the game.

Four games included a challenge and/or competition element. The challenge element was included by formulating goals by the player related to a healthy diet. The competition element was included by playing against other players. This is closely related to the interaction element. The interaction element was included in two other games, also by playing with other players. One study gave the player additional points when goals were achieved. These results indicate that story and decision making are the most important game elements. Given that they are most present in the games.

A limitation of these studies is the fact that only three studies reported game elements and one of them reported game elements related to fun. Three studies gave a description of the games and ten studies did not describe game characteristics at all. Another limitation is that the target group of these studies mostly represent children or adolescents. This makes it difficult to determine the preferences of adults related to the game elements.

The results give an indication of the elements that are most important based on the frequency they are used in games.

4.2.2 Theories behind serious games and effects on health and behavior

Most of the games are grounded in some type of theoretical background. With a majority that is based on Social Cognitive Theory (SCT), or on a combination of theories including SCT. Table 10 gives an explanation of the different theories. Table 11 presents the theories on which the games are based and the behavior change methods that are derived from the theories. In the last two columns the effects of the behavior change methods on health outcomes and behavior change are summarized.

Table 10: Theories explained	
Theory	**Based on**
Social Cognitive Theory	*"The social cognitive theory posits that behavior, personal factors, and the environment are interrelated and work together to achieve behavior change" (Thompson et al., 2007, p.908)*
Elaboration Likelihood Model	*"The elaboration likelihood model posits that the amount of attention and effort devoted to processing a message is determined by ability and motivation" (Thompson et al., 2007, p.910-911)*
Behavioral Inoculation Theory	*"The behavioral inoculation theory posits that "inoculating" or mentally preparing an individual to resist temptation not to perform a behavior" (Thompson et al., 2007, p.911)*

Table 10: Continued	
Self Determination Theory	*"The self determination theory posits that behavior is intrinsically or extrinsically motivated" (Thompson et al., 2007, p.910)*
Intrinsic motivation	*"Behavior that is intrinsically motivated is performed for the satisfaction it brings" (Thompson et al., 2007, p.910)*
Extrinsic motivation	*"Extrinsically motivated behavior is performed for a specific reason" (Thompson et al., 2007, p.910)*
Theory of reasoned action	*"According to the theory of reasoned action behavioral change is determined by behavioral change intention, which is codetermined by attitudes toward the behavior and the subjective social norm" (Peng, 2009, p.119)*
Health belief model	*"According to the health belief model, perceived susceptibility, perceived severity, perceived benefits, and perceived barriers predict the likelihood a person will adopt a recommended preventative health action" (Peng, 2009, p.119)*

	Game type	Theory	Change methods	Functions	Health outcomes	Behavior change outcomes
Table 11: Theories and change methods						
Skoglund (2007)	Other	Not reported	1) Reinforcement 2) Self-efficacy messages 3) Modeling, 4) Rehearsal 5) Problem solving, 6) Decision making	Not reported	Improved asthma outcomes	Increased knowledge
Lieberman (2001)	Other	SCT	1) Role models 2) Simulations 3) Repetition 4) Feedback and Motivation	1) Role-model characters 2) Customizable self-care regimens 3) Constant rehearsal of self-care and prevention skills, 4) Supportive and informative feedback on players' health choices in the game	Decrease medical care	Increased knowledge, self-efficacy, better self-management
Kato et al. (2005)	Other	Self-regulation model, SCT, learning theory	Not reported	Not reported		Improved treatment adherence Increased knowledge, improved self-efficacy
Silverman et al. (2002)	Other	Unclear	1) Create social pressure 2) Problem-based learning 3) Student-centered learning 4) Simulation	1) By letting know what others would do 2-4) Not reported		Shifting intentions

Table 11: continued						
Thompson et al. (2007)	Diet&physical	SCT, Elaboration Likelihood Model, Behavioral Inoculation Theory, and Self Determination Theory	1) Goal setting, 2) Goal review 3) Problem-solving and decision making 4) Enhance knowledge 5) Tailoring 6) Modeling	1) Goal setting is tailored to player characteristics they report. Players set specific, short-term, measurable goals 2) Checking whether goals set in the previous episode were attained. 3) Identify the problem that kept them from attaining their goal, select a plan for over-coming it, and decide whether to retry the goal. 4) Minigames, incorporated into game play 5) Questions answered during the game-player profile setup 6) Role-character	Not reported	Not reported
Peng (2009)	Diet&physical	Theory of reasoned action, health belief model, social cognitive theory	1) Tailoring 2) Modeling, 3) Intrinsic motivations 4) Feedback and review 5) Rewards 6) Goal setting	1) Enter personal data, provide tailored information about nutrition 2) Creating avatar, role-playing and experiment with food selections and exercise control 3) Not reported 4) Trial and error 5) Is game element 6) Manage daily calorie consumption		Increased knowledge (short term) Increased self-efficacy, increased perceived benefits
Munguba et al. (2008)	Diet	Not reported	1) Tailoring 2) Decision making	1) Enter personal data 2) Select diet	Not reported	Increased nutrition knowledge
Baranowski et al. (2003)	Diet	SCT	1) Challenge 2) Goal setting 3) Decision making 4) Goal review 5) Problem solving 6) Tailoring	1) Prepare recipes in virtual kitchen 2) Goal setting regarding recipes 3) Choose between favorite fruit, juice, or vegetable 4) Assessment of whether the goal from the previous session was completed 5-6)Not reported		More fruit and vegetable intake
Hus et al. (2003)	Other	Precede-proceed model	Feedback	Health line, Quiz and explanation when wrong answer	No effect on asthma	

31

Table 11: continued						
Ni Mhurchu et al. (2006)	Physical	Unknown	Action by doing	EyeToy camera, dance mat, and Playstation 2		Increased physical activity Boys more physical active than girls
Epstein et al. (2007)	Physical	Unknown	Action by doing	Dance mat, Gamebike, Playstation 2		Increased physical activity for non-overweight children, not for overweight children
Warburton et al. (2007)	Physical	Unknown	Action by doing	Gamebike	Increased VO$_2$ max. Greater reduction in systolic blood pressure	
Graves et al. (2007)	Physical	Unknown	Action by doing	Wii game console	Increased energy expenditure	
Graves et al. (2008)	Physical	Unknown	Action by doing	Wii game console	Increased energy expenditure	
Lanningham Foster et al. (2009)	Physical	Unknown	Action by doing	Wii game console	Greater energy expenditure No differences between sex or age.	
Baranowski et al. (2008)	All four types	Diet: SCT Physical: Action D&P: SCT Other: SCT	**D:** Repetition, feedback, rewards, tailoring, decision making, goal setting, problem solving, modeling **P:** Action by doing, goal setting, self motivating, reward, self efficacy, environment change, modeling, goal review, problem solving, challenge **D&P:** Goal setting, problem solving, decision making, rewards, modeling **Other:** Intrinsic motivation and see diet change methods.	Not reported		**D:** small but diffuse enhancement of nutrition knowledge and dietary intake. **P:** Physical activity **D/P:**dietary change and increased physical activity. **O:**increased knowledge, self-efficacy, better self-management.

Most games affected health outcomes and/or health related behavior. The games that focused on diet change used methods such as tailoring, decision making, goal setting, problem solving, repetition, feedback, rewards and modeling. It should be noted that only three studies about diet change games were included. One reported unclear outcomes. The other studies reported (small) enhancements of nutrition knowledge, dietary intake, and increased intake of fruits and vegetables.

Physical activity games mostly used action by doing as a change method. Only Baranowski et al. (2008) reported other change methods that are used in physical activity games. The effects of these games varied in outcomes. Studies reported increased energy expenditure, increased VO$_2$ max. (aerobic power) and heart rate (HR) outcomes, or increased levels of physical activity.

The diet and physical activity games showed resemblances between the methods that are applied by the diet change games. It is remarkable that they did not apply action by doing as a change method, like the physical change methods did. The outcomes varied between increased physical activity, increased knowledge (short term), increased self-efficacy, increased perceived benefits, and dietary change. It should be noted that only three studies (two within the meta-analysis) reported outcomes.

The other health related games also showed resemblances between methods that are applied in diet change games. Some studies reported that they used intrinsic motivation. The outcomes of the studies varied between increased knowledge, self-efficacy, and better self-management.

All studies varied in study design, data gathering methods and measurements. In addition, most of the studies were conducted with relative small sample sizes.
Because of this variety it is difficult to draw reliable conclusions. However, some methods are applied in several types of games and showed a variety of outcomes related to health and/or behavior change. This suggests that these methods affect health outcomes and/or behavior outcomes. Although, it is difficult to determine which method (or combination of methods as most of the games used a combination) led to specific outcomes. This indicates that more research is needed to understand the relation between change methods and their effects. It should be noted that within the scope of this research it was not possible to investigate the relation between methods and effects. In addition, most change methods are grounded in well established behavior theories. Therefore it is assumed that these methods are effective in changing behavior.
Given that most of the games are grounded in SCT it indicates that this is the most important theory for a serious game that aims behavior change. McAlister, Perry & Parcel (in: Glanz et al., 2007) state that one of the key constructs of SCT is self-efficacy. Self-efficacy refers to the belief of a person to be able to carry out a particular behavior. A method that is used to increase self-efficacy is modeling. Another important construct of SCT is observational learning, which is also closely related to modeling. Also, self regulation is central to SCT. Self regulation refers to the capacity of a person to manage himself. Two methods that increase self regulation are goal-setting and feedback (Bandura in: Glanz et al., 2007). This indicates that modeling, goal setting and feedback are the most important methods mentioned in the games. It should be noted that feedback is also a criteria for the meaning component.

4.2 Conclusion

The literature review shows that there are little serious games for adults that aim to change health related behavior. This means that there is little known about the needs of adults related to such a game.
In addition, the majority of the studies paid little attention to the functionalities of the game elements. However, the fact that some game elements, like story and decision making, were mentioned more than other elements indicates that these elements are most important. Baranowski et al. (2008) suggest that the inclusion of a story and fantasy in a game is important to engage the player. As mentioned in Chapter 2, it was difficult to determine how the game elements should be applied in order to achieve an engaging experience by the player. Therefore the game element story was left out this research. Based on these results it can be said that the game element decision making is most important, followed by challenge and competition. Interaction and rewards are less important.

The results indicate that Social Cognitive Theory is the most important theory for the development of a serious game that aims to change behavior. The most important behavior change methods related to SCT are modeling, goal setting and feedback. The other methods, tailoring, action by doing, motivation and providing information are also included in this research because they all led to some sort of effect and to test whether the literature is in agreement with the needs of the adults with (a high risk for) type 2 diabetes.

Table 12 gives an overview of the game elements and behavior change methods and functionalities that were selected from this literature review. It should be noted that some game elements are also applied as behavior change method, such as rewards and decision making. Also, some methods are indicated as game elements in the studies. For the convenience it is decided to use the categorizing based on Table 5 (Chapter 2).

Table 12: Requirements and functionalities	
Game elements	
Decision making	• Choosing between different options • Strategic decision making
Challenge	• Challenging goals • Prepare recipes in virtual kitchen
Interaction	• With other players
Rewards	• Getting points
Change methods	
Modeling	• Role-model characters • Creating avatar
Goal setting	• Personal goals
Reflection/feedback	• Rehearsal of skills • Quiz • Explanation wrong answer
Tailoring	• Enter personal data • Providing tailored information
Enhance knowledge	• Mini-games

5 Belief in a serious game: results of the survey

The aim of this survey is to get a general idea about the interest of adults in a serious game as a tool for changing lifestyle and in what form they would like to have it.

5.1 Results

Respondents

A random sample was conducted among 70 respondents, aged 18 and above, that had a clear understanding of the Dutch language. Three of the respondents were under the age of 18 and are excluded. More than half of the respondents are men (54%). The average age is 32 (SD 13.80) whereby the average age of men was 27 years (SD 9.00) and the average age of women was 39 years (SD 15.39). More than half of the respondents played games (57%) and within this group 68% are men and 32% are women. Most of the respondents play action games (18%) and strategy games (16%). Only 3% plays education games. Most of the respondents play less than five times a month (21%), followed by more than twenty-five times a month (14%). The mean is between eleven and fifteen times a month.

Survey

The results show that most of the adults agree that a serious game can support them in changing their lifestyle (75%). Most of the respondents agreed that the game needs to be tailored (81%) in order to set personal goals. Almost 70% of the respondents also agreed that the game needs to have high quality graphics and look realistic. These results indicate that these are important requirements for the game. Subsequently, a two player option, providing the game on a mobile device and being physical active during the game are important. Approximately half of the respondents agreed that the game needs to provide information or that it can be played online. It is remarkable that half of the respondents agreed that these requirements are needed. This indicates that these requirements are not core requirements but that they, are additional. Another explanation may be that these requirements are only important to specific groups. Table 13 presents the outcomes of the survey.

Table 13: Results agree/disagree questions			
Statement:	**Positive in %**	**Negative in %**	**Missing in%**
A computer game can be supportive in changing lifestyle	75	21	5
I would like to use a game that aims to be supportive in changing lifestyle	48	48	5
A computer game that aims to be supportive in changing lifestyle needs to look realistic	67	30	3
A computer game that aims to be supportive in changing lifestyle needs to have high quality graphics	69	28	3
A computer game that aims to be supportive in changing lifestyle needs to have a two or more player option	60	34	6
A computer game that aims to be supportive in changing lifestyle needs to be played online	46	48	6
A computer game that aims to be supportive in changing lifestyle needs to be tailored in order to set personal goals	81	18	2
A computer game that aims to be supportive in changing lifestyle needs to be provided on a mobile device (like a Gameboy or Nintendo DS, mobile phone).	58	37	5
A computer game that aims to be supportive in changing lifestyle needs to be informative	52	44	5
A computer game that aims to be supportive in changing lifestyle needs to be played actively	57	39	5

Given that interventions focused on lifestyle change mainly interest women it is important that the serious game is also appealing to men. Therefore it is tested whether there were significant differences in opinions about the statements between men and women. The results are listed in Table 14.

According to the Mann-Withney test more men belief that a computer game can be supportive in changing lifestyle than women (P>0,05). However, 54% of the men would like to use it. This indicates that despite the belief that such a game can be supportive in changing lifestyle, this not directly leads to the use of the game. This difference in agree and use is relatively smaller for women.

Furthermore, the results show that women find it more important that the game has high quality graphics than men. According to the Mann-Withney test there are no other significant differences in opinion between men and women.

Table 14: Differences between sexes				
Statement	**Sex**	**Positive %**	**Negative %**	**P-values Mann Withney-test**
A computer game can be supportive in changing lifestyle	Men	92	8	**0,002**
	Women	61	39	
I would like to use a game that aims to be supportive in changing lifestyle	Men	54	46	0.511
	Women	45	55	
A computer game that aims to be supportive in changing lifestyle needs to look realistic	Men	58	42	0,216
	Women	83	17	
A computer game that aims to be supportive in changing lifestyle needs to have high quality graphics	Men	58	42	**0,043**
	Women	86	14	
A computer game that aims to be supportive in changing lifestyle needs to have a two or more player option	Men	67	33	0,605
	Women	59	41	
A computer game that aims to be supportive in changing lifestyle needs to be played online	Men	47	53	0,845
	Women	52	48	
A computer game that aims to be supportive in changing lifestyle needs to be tailored in order to set personal goals	Men	89	11	0,174
	Women	73	27	
A computer game that aims to be supportive in changing lifestyle needs to be provided on a mobile device (like a Gameboy or Nintendo DS, mobile phone).	Men	47	53	0,073
	Women	79	21	
A computer game that aims to be supportive in changing lifestyle needs to be informative	Men	47	53	0,144
	Women	64	36	
A computer game that aims to be supportive in changing lifestyle needs to be played actively (like the Wii Fit)	Men	50	50	0,511
	Women	71	29	

5.2 Conclusion

This survey shows that the core requirements for both, men and women, are tailoring the game and a realistic environment. Followed by a two player option, providing the game on a mobile device, and physical activity during the game. Less important are the requirements information and online playing. For women are high quality graphics also a core requirement.

Furthermore, adults and especially men, agreed that a serious game can support them by changing their lifestyle. It should be noted that for men the belief that a game could be supportive in changing lifestyle, will not directly leads to the use of the game. However, still over 50 percent of the men would like the use it. Additionally, more than 40 percent of the women would like to use a game that aims to support lifestyle change. This suggests that a serious game is a possible approach to stimulate healthy lifestyles of adults.

It should be noticed that the survey only gave a general idea about the interest and preferences of adults according to a serious game that supports them in changing their lifestyle. It did not give information about how the requirements should be implemented and not all game elements and behavior change methods were tested.

The next chapter discusses the results of the structured interviews and the focus group, which tested the requirements and functionalities needed for the game.

6 Results structured interviews and focus group

The aim of the structured interviews is to gain insight into the preferences of young adults regarding to the game elements, behavior change methods, and game environment. The aim of the focus group is to gain insight into the preferences of type 2 diabetes patients regarding to the game elements, behavior change methods, and game environment.

6.1 Results structured interviews

6.1.1 Background respondents
The structured interviews are conducted among 5 respondents. Two of the respondents are women. All respondents are highly educated and between 20 to 25 years old.

6.1.2 Results first part: functionalities of the applications
Tables 15-17 show the results regarding to the game elements, change methods, and game environment. Within the game elements it appeared that none of the respondents preferred to play the game without other players. This shows that interaction is an important requirement whether with persons in real life or by a network. Challenging others and choosing between different options was chosen by only one respondents. All other elements scored moderately.

Table 15: Game elements	
Game design elements	**Respondents (out of 5)**
Interaction	
• Performing exercises together	2
• Playing the game alone	**0**
• Possibility to play with a group, because of short duration of the game	2
• Two player option in real life	2
• Two player option	3
• Exchange recipes with others	2
Decision making	
• Choosing between different options (multiple choice questions)	1
Rewards	
• Giving compliments	2
• Speedbonus	2
Challenge	
• Difficulty level increases	3
• Building up reaction time	5
• Preparing recipes in real life, with guidance of virtual cook	3
• Preparing recipes in virtual kitchen	2
Sense of control	
• By using balance board	3
• By using a Gamebike whereby you decide the speed of the game	2
Competition	
• Keep up high scores	2
• Challenging others	1

Results according to the behavior change methods suggest that the functionalities exchange information via website, rehearsal of skills and the functionalities regarding to providing information are not appealing.
The methods that were preferred most were:

1. Motivation, a real person that gives advice
2. Tailoring, enter personal data and choosing recipes
3. Reflection, after and during training
4. Action by doing, intense physical activity
5. Modeling, both being visible or creating own character
6. Goal setting based on personal data

It is remarkable that the respondents prefer information after the training via a website, but did not prefer to exchange information with others.

Table 16: Behavior change methods	
Behavior change methods	**Respondents (out of 5)**
Motivation:	
• A coach (real person) gives directions via a mp3-player	5
• A virtual coach gives directions	2
• Exchange information via website	**1**
Tailoring:	
• Choosing own work-out scheme	3
• Register data about weight, height and other health related data in order to formulate personal goals	4
• Choosing recipes based on difficulty, amount of calories, cooking methods and preparing time	4
• Choosing music during work-out	2
Reflection/feedback	
• During training feedback on performance	4
• After training information about performance on a website	5
• Rehearsal skills	**0**
Action by doing	
• Intense physical activity	4
• Moderate physical activity	2
Modeling	
• Being visible in the game (via camera)	5
• Creating your own character	4
Goal setting	
• Based on personal data	3
Providing information	
• Asking for instruction films for more information	**1**
• Getting advice during work-out about sport outfits, sport shoes, nutrition, preventing injuries	**1**
• Information about nutrition labels	**1**

Results regarding to the game environment suggest that the respondents found the environment less important.

Table 17: Game environment	
Game environment	**Respondents (out of 5)**
Virtual	1
Realistic	1
Unrealistic	0
Futuristic	1

Overall it can be said that the functionalities regarding to the behavior change methods scored better than the functionalities regarding to the game elements. This indicates that the functionalities related to the change methods have a positive effect on the play component. These results show which functionalities have a high priority (4 or 5 respondents preferred the functionality), moderate priority (2 to 3 respondents preferred the functionality) or no priority at all (o to 1 respondents preferred the functionality). See appendix I: Priority list.

6.1.3 Results additional questions

The answers are listed thematically. Firstly, the answers related to the game content will be discussed. Subsequently, the answers related to the device, game environment, the character, actions done by the character, and additional remarks will be discussed.

Game content
Three respondents would like to have a game that stimulates physical activity and healthy eating habits. None of them would like a game that is only focused on nutrition and two of them would like a game about physical activity alone. The respondents that liked both aspects in the game had little knowledge about nutrition and would like to learn more about nutrition by means of a game. The respondents that only liked the physical activity aspect liked already sports and had no interest in nutrition at all.

Figure 5: Wii Physical active

One respondent indicated that the game would be more fun when the nutrition aspect could be tailored. Another respondent added that it would be nice when information would be provided about healthy food related to the physical activity that was performed during the game.
Another remark made by a respondent was that the nutrition aspect in the game must not consist solely of information. When it is necessary to provide information the respondent suggested to do it with "did you know" messages (in Dutch: wist-je-datjes). The respondent added that the game also should focus on the adherence to healthy eating habits on the long term. The respondent suggested that keeping up statistics of your eating habits could help regarding to adherence. One of the respondents that would like a game about physical activity stated that it was acceptable when after a level information was provided about healthy nutrition. Not during the game because it would only interrupt. Two respondents suggested that it may be nice to have a forum on which you can see the performance of other people or to get to know other people in a similar situation.

Device
One of the respondents indicated that he would like to have the possibility to link several applications. Like scanning nutrition labels in the supermarket during shopping with an I-phone in order to get direct information about how healthy the food is you want to buy.
The game console was chosen by two respondents, because it gave them the feeling of recreation. One of these respondents remarked that he would only chose a game console when there were no financial barriers. Otherwise he would chose for a personal computer.
One respondent remarked that he did not want to play games with his telephone because it reminded him of his work. Via the telephone he regularly checked is e-mail or sms. A (serious) game was in his opinion something to relax. These outcomes indicate that younger adults see a serious game as something that is used as recreation.
One responded said he would like to have the game on his Ipod or telephone. For example, by downloading training schemes with music on your mobile phone or mp3 player and that after completing the training credits will be provided for a small game.

The game environment
The respondents gave the impression that the game environment did not interested them very much. Most of the respondents liked a realistic environment. It is not necessary that the game environment is very detailed, but at least recognizable.

One respondent added that it was maybe possible to give the player the opportunity to choose between several environments. For example, the player could choose between realistic environments or unrealistic environments before starting the game.

One respondent answered that he found it important that the game could keep him concentrated. This could be reached by a game that has interesting graphical features. This can be with an unrealistic environment but also with a realistic environment.

The character

In accordance with the environment the respondents preferred a realistic character. Four respondents also reported that they would like to create a character by themselves. Especially a character that resembled to their own character and appearance.

One respondent remarked that it would be nice when it is possible to create a character that resembles your situation at this moment and a character that you would like to be in the future. This can be used as indicator for the goal you want to achieve. One respondent preferred a first player game in which the character is not visible.

Figure 6: Create your character

Actions done by the character

Most of the respondents would like the character to perform daily tasks, not unrealistic moves. One respondent wanted the character to perform sports.

Additional remarks

The respondents also indicated that the game needs a competition element, that the player needs to be physical active to drive the game, that the game can be played with others, and a quick reaction element in the game.

Also, the respondents stated that they would not buy the game when there are a lot of attributes needed in order to play the game. They would like an application that is reasonable priced, with the possibility to extend it with attributes that are also reasonable priced. These attributes are extra but not necessary to play the game.

6.2 Conclusion structured interviews

In general the respondents preferred the functionalities related to the behavior change methods more than the functionalities regarding to the game elements. This indicates that these functionalities have a higher priority than the functionalities regarding to the game elements. The game environment is less important and has a lower priority than the functionalities regarding to the behavior change and game elements. Most important is that the game environment is realistic.
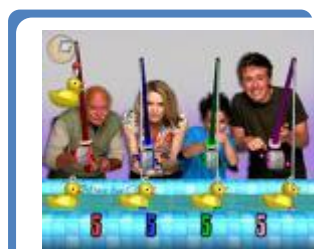
Figure 7: Being visible in the game (Eye Toy)

The functionalities that are preferred by the respondents regarding to the character are: a camera in order to be visible in the game or creating an own character. Motivation can be best provided in the game by a person that is represented by a real person. Feedback is preferred during and after work-out.

The requirements with the highest priority regarding to the game elements are competition and challenge. The functionality preferred related to the challenge element is quick reaction time. Playing the game alone, choosing between different options, and challenging others were not appealing at all.

The results of the additional questions show that physical activity is an important aspect in the game. A nutrition aspect is less appealing which means that it is especially important to understand how this aspects needs to be incorporated in the game. Tailoring nutrition aspects was indicated by the respondents as a solution. For tailoring the nutrition aspect the results suggest that the functionality: choosing recipes based on difficulty, amount of calories, cooking methods and preparing time, or by getting information that is based on personal characteristics is the best way to

do it. Providing solely information was not preferred. In addition, it is relevant to give advice in the game about adherence to lifestyle changes and not only telling what healthy choices are.

A remarkable outcome is that two respondents indicated a forum on which information could be exchanged about performance, while results of the first part of the interview showed an low score for this aspect. Also a competition element was preferred by the respondents according to the outcomes of the last part of the interview, while in the first part this element scored moderately. A possible explanation can be that the respondents in the first part unconsciously made trade-offs between the elements incorporated in one application or that they saw "quick reaction time" as a competition element. In this research it was assumed that this was a challenge element. Challenge and competition are strongly related to each other.

Overall it can be said that the respondents preferred a game console on which the game could be played, in order to give them the feeling that they were doing something to relax. The game environment, the character and the actions to be performed need to be realistic, but it is not necessary that it is very detailed, as long as it can be transferred to reality. It was experienced as especially fun when the respondents could modify their own character for in the game.

6.3 Results focus group

6.3.1 Background respondents

The focus group was conducted among 5 respondents. Four of them were men. One respondent is the chairmen of the Diabetes Union of the Netherlands. He did not have diabetes, but his wife did. The age of the respondents varied from 62 to 73 years old. All respondents had the Dutch nationality. Four of the respondents were higher educated and all respondents had retired. Four of the respondents received treatment for their diabetes, of which three received medication.

A minority experienced limitations caused by their diabetes. These limitations are worsening sight, following a diet, using medications and problems losing weight. All respondents tried to change their eating habits and to be more physical active. They tried to change their eating habits by following a diet. A diet that was based on less carbohydrates worked. Also because it was accompanied by the support of a nutritionist. To be more physical active respondents tried to do as much as they could by walking or cycling, and going to the gym. This worked not for losing weight, but it worked for reducing muscle pain.

All respondents were motivated to change their eating habits. Three respondents were probably motivated to be more physical active. Two respondents certainly believed that they were capable to change their eating habits or physical activity by themselves, one certainly did not.

Three out of five respondents owned a personal computer at home. All with an internet connection. None of the respondents played videogames. Reasons for not playing videogames are: not interested, too busy, and I use the computer already too much for other purposes.

Three of the respondents slightly believed that a game could support them by changing their lifestyle. One respondent did not believe that a game could be supportive in changing lifestyle. Overall the respondents expected that they would not use a game to change their lifestyle.

6.3.2 Game elements

Decision making

The participants responded that making decisions is important in order to transfer information. It was of less relevance how the decisions should be made. For example, by answering multiple choice questions or choosing the right picture did not matter. Most important is that a decision has to be made among different options. However, the participants did not like the idea to make decisions under timer pressure. According to the participants it was more important to take the time to understand the situation than to give quick answers.

Rewards

The participants found it important that good performance needed to be rewarded, but that the reward needed to be adjusted to the difficulty of the performance. For example, a very enthusiastic reaction every time you have answered a simple question was irritating according to the participants.

Interaction
The participants preferred to play the game without other players. A majority of the participants remarked that they were soloists.

Competition
Competition was not preferred at all.

6.3.3 Change methods

Feedback / repetition
Feedback is seen as an important aspect of the game. The participants find it important to get feedback in order to determine how they performed. Participants suggest that it was important to get direct feedback after an action. For example, when they had answered a question, they wanted immediately response. In addition, they preferred an overview of their performance after a session/level in order to see whether they had understand the things that were elaborated in the game. In case of poor performance the participants preferred to have the choice to do it again, in order to understand the things learned by the game.

Motivation
The participants all liked it to be guided in the game by a virtual coach. One respondent suggested to be guided by real experts regarding to diabetes in the game.
They also found it important to see whether the goals to be achieved came closer. Participants indicated that they did not found it motivating when it was possible to see performances of others.

Tailoring and goal-setting
All respondents agreed that it was important that the game could be adjusted to personal goals and preferences.

Action by doing
During the focus group it emerged that the most of the participants thought that only intense activities had an effect and therefore preferred intense physical activity. However, moderate physical activity has a great effect on the blood circulation. Most of the respondents were focused on losing weight, which takes a little longer to see an effect with moderate physical activities.

Modeling
Role-playing by using a character was not important. The respondents preferred a virtual coach that guides them through the game. It is possible to do that without being/playing a character

Problem-solving
Problem-solving regarding to diabetes problems was not desired in the game.

Providing information
During the discussion the participants showed a strong preference for information about their disease. Especially related to nutrition and to a lesser degree related to physical activity. They pointed out that they especially preferred written information and that the information was uniform. This meant for them that all nutritional values were expressed in the same measures.
It was also important that the participants could ask for more information in the game when they needed. The participants agreed that it would be nice when the game could be adjusted to the individual. That the information provided by the

Figure 8: Screenshot Nutrition Decision.

game was adjusted to the personal situation in order to set personal goals. Information that was indicated as most important by the participants is information about calories, carbohydrates and fat. Additionally the participants suggested that it was relevant to incorporate images of the inside of the body (this can be an animation or a movie of a real body) that shows what happens in the body when consuming certain food.

One last remark was that the information provided at one time should be not too much.
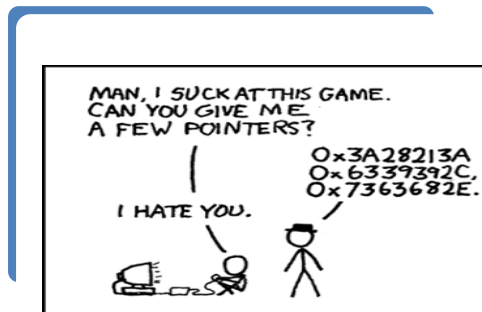
Figure 9: *"Can't they talk normal language?"*

6.3.4 Additional remarks
During the discussion the respondents remarked several times that walking or cycling in nature was more appealing to them than playing a game. Additionally, the participants found that the games had an overwhelming visual design, which distracted them from what the game was all about. They also found the use of language hectic, complicated and too fast. Or as one responded put it: "*I find the language that is used, much too hectic! It is typical American. Can't they say it in normal language?*" One of the participants asked whether they were the right target group. This indicates that the participants are not interested in a game that could support them by changing their lifestyle.

On the other hand, when a fragment of the game Innov8 was shown, that is a more businesslike/simulation game, the participants seemed positively surprised. Examples of reactions on this fragment were: *"It is calmer and not so hectic". "I think that this is much more clarifying for elder people"* and *"I like this more than the other fragments".* This game was focused on adults. The other games were focused on children or adolescents. This indicates that there is an interest in a game as support to change lifestyle.

Additionally, the participants remarked that they did not like it to use attributes in order to play the game. For example, participants reacted on a game which is played with a balance board with: *"I do not like to dance funny on a stupid board".*

Finally, demonstrating certain skills during the game that are needed to, for example, use a glucose meter was preferred by most of the respondents.

Figure 10: Screenshot Innovv8

6.4 Comparing results

The preferences of younger adults and type 2 diabetes patients show some resemblances but also essential differences. In Table 18 the most important differences are summarized.

Table 18: Differences in preferences		
Elements	Younger adults	Type 2 diabetes patients
Interaction	Playing together	Playing alone
Competition	Preferred	Not preferred
Decision making	Not preferred	High priority
Rewards	Moderate priority	High priority
Sense of control (by using attributes)	Only when attributes are reasonable priced	Not preferred
Challenge	High reaction time	Not preferred
Game content	Focus on physical activity	Focus on nutrition
Providing information	Not preferred	High priority
Game	Realistic, moderate degree of detail	Realistic and truthful, High degree of detail.

Probable explanations for these differences are the degree of experience with interactive media. Younger adults grew up with the use of several interactive media applications and got used to the use of interactive media. Interactive media became more and more a part of daily life. In several areas interactive media is used, at work sites, in the classroom and during leisure time. The interactive media made it possible to do certain tasks much more faster. The present environment is more focused on quickness, processing great amounts of information and on the other hand on entertainment/leisure time. This can explain why older people are more interested in a game that provides less information at one time and why type 2 diabetes patients do not prefer challenge and competition.

Additionally, a relevant difference between both groups is that the younger adults did not have developed type 2 diabetes. This can explain why type 2 diabetes patients are less interested in physical activity. Being less flexible is related to the disease and aging.

However, both groups show also some resemblances. Both groups preferred a realistic environment (but different amount of detail). They also agreed that feedback during and after performances was needed. Finally, both groups preferred that the game could be adjusted to personal goals and preferences.

6.5 Conclusion focus group

Overall the diabetes patients were not interested in a serious game that could support them by changing their lifestyle. Yet, a serious game that is more businesslike and more like a simulation is appealing to the participants. This indicates that there is an interest in a serious game but that the name "game" may not be suitable.

When a game will be developed then it is very important that the game is focused on providing information. Whereby, little amounts of information at one time will be provided. Besides providing information are the following change methods and corresponding functionalities important:

- Motivation. By guidance by a virtual coach or real life expert.
- Tailoring and goal setting. Based on personal data.
- Feedback. After and during the game/training.

Most important game elements and functionalities are:
- Decision making. Choosing between multiple options.
- Rewards. adjusted to the difficulty level.

Finally, the game environment needs to be realistic, with a high degree of detail, and it t is highly preferred that the visual design is clear and clarifying.

7 Interviews with experts

The aim of the interviews is to gain insight into their opinion about a serious game that aims for changing eating habits and sedentary lifestyle and the requirements that are needed.

7.1 Results

7.1.1 Background respondents
The following experts responded to the calls:

Frank Nagelkerke
Nagelkerke is the secretary of the board of Fyzob. Nagelkerke participated in the design of a protocol for a physical activity program for type 2 diabetes.

Rinske Jeeninga
Is a physiotherapist at the practice 'De Oude Apotheek' located in Utrecht (the Netherlands).
Which recently started with a treatment program for type 2 diabetes patients.

Marjolein van den Diepstraten
Van den Diepstraten is a dietician at Thebe. Her specialization is sport dietetics.

Casper Harteveld
Harteveld is a PhD student at the Technical University of Delft. He developed the game Levee Patroller and formulated the underlying philosophy of this game. Currently he is testing the influence of Levee Patrollers. In his research he mainly integrates theories from psychology, organizational science, and game design.

Pamela Kato
Kato is a health psychologist. She was the founding president and CEO of HopeLab. At HopeLab she was one of the developers of the game Re-mission. This game enhances adherence to treatment among young adolescents with cancer. Kato is currently working on developing and testing a clinically validated serious game to train medical residents in patient safety.

7.1.2 Advice from Nagelkerke and Jeeninga
Most of the time patients are referred to the physiotherapist by a general practitioner. This means that in general patients are little motivated to become more physical active (F. Nagelkerke, personal communication, June 8, 2009; R. Jeeninga, personal communication, June 18, 2009).
In addition, it takes time before patients can see any effect of the treatment. This can be very demotivating. To motivate patients the treatment is performed in groups (R. Jeeninga, personal communication, June 18, 2009).

Nagelkerke (personal communication, June 8, 2009) suggested to incorporate the game in the treatment. People that have developed type 2 diabetes have problems related to eating habits and physical activity. Most of the time they need and extra trigger to change their lifestyle. This means that they will not search for solutions by themselves, but they rather need to be referred by a general practitioner to go to a physiotherapist and/ or nutritionist before they will search for support. This is the first step.
The treatment program that is designed by Nagelkerke and others involves a part that takes place at the clinic and a part that takes place at home. The game could be an added value in stimulating the patients to do their exercises at home (F. Nagelkerke, personal communication, June 8, 2009). Jeeninga (personal communication, June 18, 2009) agrees with Nagelkerke (personal communication, June 8, 2009) that a game can be a part of the treatment, because it is for the patients difficult to do exercises at home.
Although, Jeeninga (personal communication, June 18, 2009) stresses that it is important that the game is a part of the treatment. When patients are send home with the message: "this is a game that will help you", they will not take it serious. When it is already used during the treatment at the clinic patients can get familiar with the game. When an physiotherapist recognizes the usefulness of such

an intervention by using it during the treatment, patients will be more willing to perceive the game as a useful application. Patients see the game then as a part of their treatment instead as a game that enhances a healthy lifestyle. This is an important difference, according to Jeeninga (personal communication, June 18, 2009).

According to Jeeninga (personal communication, June 18, 2009) the level of physical activity that is needed is moderate intense, because it is for diabetes patients important to lose weight and to enhance the blood circulation. The blood circulation can be enhanced by little physical activity, but in order to lose weight, more intense movements are important. According to Jeeninga (personal communication, June 18, 2009) patients need to get the feeling that they did a work-out. Especially because effects are not always visible. Getting tired and sweaty during workout are visible effects and gives the patient the feeling that it had an effect. By performing running exercises or exercises whereby the use of the limbs are involved are good exercises to incorporate in a game. Dynamic movements are important. Jeeninga (personal communication, June 18, 2009) suggests that it would be nice to incorporate condition tests in order to make effects visible on the long term, or for direct visible effect it may be possible to connect a heart rate to the game and when the heart rate is to high the bike or treadway lowers speed.

Jeeninga (personal communication, June 18, 2009) states that it is important to create a realistic environment that enhances physical activity, like a park in which they can run or were they can do competitions with each other. Because type 2 diabetes patients mostly are older people it is important to create a realistic environment. Otherwise they will perceive it as a normal videogame.
It is according to Jeeninga (personal communication, June 18, 2009) important to be aware that the patients do not overburden their joints. Therefore it is important to incorporate at certain times a pause in the game in which then will be asked whether the patient feels pain, how severe, et cetera and that the game than adjusts to the patients situation.
Jeeninga (personal communication, June 18, 2009) also noted regarding to the nutrition aspect in the game that it is important to be aware that when people did a work-out for about 30 minutes that they are less likely to answer questions or read information about nutrition. Therefore it is better to incorporate short messages regarding to nutrition during the work out. For example: "you already burnt x calories. Did know that a cookie is x calories? It is important to be careful with this messages because it can be demotivating. As they for example see that 30 minutes work-out only burnt 2 cookies than they think that all effort was for burning only 2 cookies (Jeeninga, personal communication, June 18, 2009).
Finally, Jeeninga (personal communication, June 18, 2009) remarked that it would be nice when it is possible to enter personal data in order to set personal goals and that it is possible to sent the results to a care giver that can give advice based on the performances. Feedback from a real person may be feel better and is an extra motivation Jeeninga (personal communication, June 18, 2009). However, Nagelkerke (personal communication, June 8, 2009) thinks that it would be better to make it figurative. Hence, that the character loses weight when it makes healthy choices regarding to nutrition and physical activity.

7.1.3 Advice from Van den Diepstraten
According to Van den Diepstraten (personal communication, June 24, 2009) there are some fairytales about nutrition and type 2 diabetes. Most people think that diabetics are not allowed to eat nutrition that contains sugar. This is not true and it is much more important to be aware of the different fat types in nutrition. The problems that are mentioned by Van den Diepstraten (personal communication, June 24, 2009 are motivation and insufficient knowledge. Most patients do not know what healthy eating habits are and what not. For example, it appeared that a patient wanted to lose weight in a very short time by consuming less calories. The patient complaint about a hungry feeling that did not go away. It appeared that the patient allowed herself only 1600 calories while 2000 calories are needed. She did not know that 2000 calories are needed. Therefore it is important to give general information about nutrition.
Van den Diepstraten (personal communication, June 24, 2009) did not know whether a game could help patients in changing their eating habits. Especially, because of the age of the patients. Most important is motivation, thus people first need to be motivated to change eating habits before they seek solutions that can support them to change. Van den Diepstraten (personal communication, June

24, 2009) did not know whether this age group would be interested in a game in general, thus it was hard to say whether they would use it to support them in changing their lifestyle.

When a game will be developed it is important that the game environment looks realistic and that the focus will be on fat and calories. The information that will be provided needs to emphasis healthy nutrition that counts for all people. According to Van den Diepstraten (personal communication, June 24, 2009) counts for the type 2 diabetes patients the same as for all other people regarding to healthy eating habits.

7.1.4 Advice from Harteveld and Kato

According to Harteveld (personal communication, June 17, 2009) it is of additional value to determine the requirements and functionalities that are needed for a serious game. However, most problems emerge during the development of the first prototype. On the other hand, Harteveld (personal communication, June 17, 2009) states that starting the development process of a prototype without determining which functionalities are needed, will leave out some functionalities at forehand that will never be tested because it is not possible to incorporate all possible functionalities. In the end it depends on the time and the budget which choices best can be made.

In addition, Harteveld (personal communication, June 17, 2009) emphasizes that it is important that the serious game has a surplus value for the target group and that despite some target groups are not interested in games, the surplus value will make them use the game.

Harteveld (personal communication, June 17, 2009) also gave the advise to develop a prototype that can be used at home. Because most people participate in research because they think it is fun to participate in a research, but are not really interested in using a game for real. Or they participate because they get a compensation for their participation. In order to gain insight whether people use the game out of intrinsic motivation, it is important to give them the game to use it at home. When they use it a lot it indicates that it has a surplus value.

According to Kato (personal communication, January 15, 2009) a serious game can turn a negative thing into something positive. For example, the game Re-mission shows that cancer medication destroys cancer cells. Cancer medication is known of the unpleasant side effects. The game emphasizes that despite the unpleasant side effects the medications fights the disease. This gives the patient motivation to maintain the treatment.

Kato (personal communication, January 15, 2009) also indicates that the environment does not need to be very detailed. As long as the game environment can be transferred to reality. For example, the game environment in which the game Re-mission takes place, is the inside of the body of a person with cancer. The game environment is not detailed, but it is clear that the game takes place in a body.

7.2 Conclusion

The results show that overall the experts think that a serious game can have an added value for the diabetes patient. However, they doubt whether type 2 diabetes patients would use a serious game to support them in changing their lifestyle. Therefore, the experts recommend to incorporate the game in the treatment program. This suggests that the health care providers are interested in as serious game.

When a game will be developed it should represent a realistic environment that enhances moderately intense physical activity.

Regarding the nutrition aspect it is important to give type 2 diabetes patients general information about healthy eating habits.

According to the game development process it is important to develop a prototype and test whether the target group will play the game out of intrinsic motivation by giving the game back to their homes. Or to integrate the game in a treatment program. Finally, it is important to emphasis the positive effects of something that is difficult to do and to maintain.

8 Conclusions and discussion

The aim of this research was to determine what functionalities a serious game, that aims to change eating habits and sedentary lifestyle of adults with (a high risk for) type 2 diabetes, must meet in order to be useful and appealing to play. Based on the philosophy of Harteveld et al. (2009) and by involving the potential users is tried to achieve this aim. In the next sections the main conclusions of the research will be elaborated followed by the discussion.

8.1 Conclusions

The first part of the research has shown that little is known about serious games that aim for behavior change for adults. While there are possibilities for a serious game as an intervention for changing lifestyle for this group, given that a majority of the adults agrees that such a game could be supportive in changing lifestyle and would like to use it. In addition, the results of the literature review have shown that serious games that aim health related behavior change had effects on health and behavior change outcomes. These effects are: changes in dietary intake, increased intake of fruits and vegetables, increased energy expenditure, increased VO_2 max. (aerobic power), heart rate (HR) outcomes, increased levels of physical activity, increased physical activity, increased knowledge (short term), increased self-efficacy, increased perceived benefits, dietary change, increased knowledge, self-efficacy, and better self-management.

It should be noted that most games were based on a theory or a combination of theories. The most important theory that is used is Social Cognitive Theory. Based on this theory the most important behavior change methods are modeling, goal setting and feedback.
According to the literature review the most important game elements are decision making and competition and challenge.
The survey has shown that the requirements and functionalities that the serious game must meet are different for men and women. For women the core requirements are tailoring the game, a realistic game environment and high quality graphics. While for men the core requirements are tailoring the game and a realistic environment.
The second part of the research gives a more in-dept overview of the requirements and functionalities for the serious game. To stimulate young adults with a serious game to change eating habits and to be more physically active, the following requirements and functionalities are most important to meet:

Table 19: Needs young adults	
Requirement	**Functionality**
Game elements	
Interaction	Two player option
Challenge/competition	Building up reaction time
Change methods	
Motivation	A real person that gives advice
Tailoring and goal setting	Enter personal data and choosing recipes
Feedback	After and during the game/training
Action by doing	Intense physical activity
Modeling	Both being visible or creating own character
Goal setting	Based on personal data
Representation	
Game environment needs to be realistic	Moderate degree of detail

In first instance the diabetes patients were not interested in a serious game, until they saw a more a businesslike/simulation game. This indicates that there is an interest in a serious game but that the word "game" may scare them off.
To stimulate type 2 diabetes patients with a serious game to change eating habits and to be more physically active, the following requirements and functionalities are most important to meet:

Table 20: Needs type 2 diabetes patients	
Requirement	**Functionality**
Game elements	
Decision making	Choosing between different options
Rewards	Adjusted to difficulty level
Change methods	
Providing information	Written, uniform, tailored and provided in small amounts at a time.
Motivation	Guidance by virtual coach or real life expert
Tailoring and goal setting	Based on personal data
Feedback	After and during the game/training
Representation	
Game environment needs to be realistic	High degree of detail

Regarding the moderating factor voluntariness it appeared that the experts expected that diabetes patients would not use the a game by themselves and that it may be better to incorporate the game as part of the treatment program. To test whether the patients would use it at home, it is recommend to give the game to the patients so they can try it at home.

The most important requirements according to the experts are: a realistic environment that stimulates moderately physical activity, the possibility to do exercises together with other patients provide general information about nutrition and emphasize that the positive effects of changing lifestyle.

Overall the requirements that are needed according to the diabetes patients and experts show resemblances, except for doing the exercises together with other patients. It could be that the experts do not know the preferences of the target group. Or it could be that the patients that receive treatment are younger than the respondents of the focus group.

Based on these results it can be concluded that there are differences between target groups related to the requirements and functionalities that the serious game must meet. This means that it is important to take these differences into account when developing the serious game.

8.2 Discussion

Reflection on the literature
Based on the philosophy of Harteveld et al. (2009) the three components play, meaning and reality are equally important in a serious game. However, findings of this research suggest that for diabetes patients the meaning and reality components are more important than the play component. The diabetes patients stressed the importance of providing information and a truthful representation of the world related to diabetes in the game. While the younger adults saw a serious game as a means to relax, which indicates that the play component is more valuable to them than the meaning component. This is in disagreement with the findings of Sun & Zhang (2005) which stated that for younger adults perceived usefulness is more important than for type 2 diabetes patients.
However, in this research it was not possible to test combinations of functionalities. This is important regarding to balancing the components. Tensions between components become visible when actually designing the game and testing it among the potential user. It becomes then clear what trade-offs need to be made. This means that further research is needed in order to determine whether the components are equally important.
Also, the survey has shown that perceived usefulness (the belief that a game can be supportive) does not directly lead to the use of the game. The percentage of men that agree that a serious game could be supportive in changing lifestyle was much higher than the percentage of men that would like to use it. While the differences in percentages of women who would like to use it were is smaller. This indicates that perceived usefulness is a stronger predictor for women than for men for intention to use the game. This is again in disagreement with the results of Sun & Zhang (2005). It should be noted that the user acceptance is not tested during this research. This means that further research is needed to test whether usefulness is a stronger predictor for older users than younger users and a stronger predictor for women than for men.

The results also indicate that the meaning component has a strong positive influence on the play component. The young adults saw a serious game as a means to relax and something that is fun to play. From this perspective the young adults gave their preferences and the results have shown that the young adults preferred the functionalities related to the change methods most. However, it should be tested whether this is still the case when the methods are put into practice. In addition, the ranging of the functionalities is based on logic reasoning. Thus it could be that some functionalities could also be ranged under a game element instead of a change a method.

Another outcome to be aware of is the fact that the diabetes patients stressed the importance of providing information. Egenfeldt-Nielsen (2005) state it is not enough to simply learn the facts and knowledge on a given topic in order to apply the things learned in real life.
On the other hand Bransford (in: Egenfeldt-Nielsen, 2005) state that it is important that the players are aware of the learning elements, otherwise the transfer will be undermined. Thus to prevent that the diabetes patients undermine the transfer it is important that information is provided. In addition it is important that this information is provided in a context that makes a transfer for the diabetes patient to the real world easy.

Harteveld et al. (2009) notice that feedback can be given during the game session or after the game session. This research shows that young adults and type 2 diabetes patients prefer that feedback is given on both moments. However, feedback during the game can have a negative influence on the immersion and engagement experienced by the player. This called Harteveld et al. (2009) the "reflection dilemma". It was not possible to test this because there was no prototype. This needs also to be tested when a prototype is developed.

Reflection on the methods
User-centered design was for this research very useful. As mentioned before the literature has shown that little knowledge was available about serious games that aim for health related behavior change that are meant for adults. Involving the potential user by asking about their needs provided insight into the core requirements and functionalities that the serious game must meet.
During the research there was no prototype available for evaluation, therefore it was not possible to test the requirements related to engagement en immersion. It could be that the requirements and functionalities resulting from this research negatively influence the engagement and/or immersion of the player during the game.
On the other hand, most user-centered design studies design and evaluate the first prototype in a too early stage which leads most of the time to a redesign of the prototype. According to Edwards, Bellotti, Dey & Newman (2003) the first prototype is developed and evaluated in a context of real use. This means that all possible requirements are already implemented without a clear view of the core requirements. This often leads to the redesign of the prototype. Additionally, when the core requirements are not properly implemented the secondary requirements are of no value. This stresses the importance of a thorough needs assessment.
The user-centered design used for this research used mixed methods in order to gather different data among different target groups.
The literature provided little information about the requirements and functionalities related to a serious game that aims to change lifestyle change for adults. However, the literature review provided a good starting point for the interviews and focus group.
The survey provided information about the interests of adults regarding a serious game that is supportive in changing lifestyle. It was a useful method, because the survey made it possible to gather information in a short period of time among a large sample. A limitation of the survey was the fact that it did not test all requirements and functionalities. Another limitation is that it was not possible to gather in dept information about the needs of the respondents. A last limitation is the fact that there is a great difference in mean age between men and women. It is possible that the differences between men and women are different when the mean ages are more the same. Therefore it may be better to conduct a survey among a larger sample size.
The structured interviews among young adults made it possible to gather slightly more in depth information about the requirements and functionalities than was possible with a survey. The structured interviews made it easy for the respondents to give their preferences related to the serious game. This made it also possible to gather a large amount of information related to the needs. With other methods, like an open interview or a survey, it would not be possible to gather this

amount of information. A limitation of the structured interviews is that it was rather time consuming to conduct the interviews, because the researcher needed to be present during the interview. This made it difficult to conduct the interviews among a large sample. Another limitation of the structured interviews is that the limited scope for respondents to answer the questions. This limited the depth of the answers.

The focus group was a good method to gather information about the needs of diabetes patients, because the focus group made it possible for the participants, which had no experience with gaming, to formulate their preferences. In first instance the participants thought that their opinions could not be useful because their lack of experience. However, during the focus group it appeared that they could clearly formulate their needs, because the game fragments and description of the game helped in explaining the functionalities. Also, the discussions with other participants helped in formulating opinions and needs. With a survey of an interview it was not possible to gather this information. In addition, because the small sample size, all participants participated in the discussions.

A limitation of the focus group was the use of some fragments that were not suitable for the participants. Some fragments gave a wrong idea of a serious game for adults. Hence, because of the availability of game fragments it was not possible to take this into account. Another limitation of this method is the small sample size. This limits the reliability. By conducting more focus groups this problem can be overcome. This was for this research not possible because of time constraints and because it was difficult to find enough participants.

The next limitations are related to both the structured interviews and the focus group. The functionalities that were tested during this research were deducted from the literature review and popular applications that enhance healthy eating habits and physical activity. This could mean that functionalities are missing. However, applications that did not include additional functionalities were excluded from the research.

Individual functionalities were tested by using examples of applications and games. These games included a combination of functions which the respondents can have taken into account when deciding whether the functionality was preferred or not. This makes it possible that when other applications or games were used, different outcomes regarding to the same functionalities can appear. Another limitation is that the respondents of the structured interviews and focus group were mainly highly educated. It might be that people with other educational backgrounds have other preferences.

The open interviews with experts gave insight into the opinions of the experts related to a serious game that aims for lifestyle change for type 2 diabetes patients. Although, it may be better to conduct a focus group with all experts, in order adjust the treatment interventions to the different fields of nutrition and physical activity, and to give the experts in the field of diabetics more insight into the technological possibilities by involving the game development experts.

Despite the limitations, the different methods demonstrated to be useful in gathering the data needed among different target groups. Especially, because the methods were adjusted to the target group.

9 Recommendations

Conduct a thorough needs assessment before developing the first prototype
It is important to be aware of the core requirements that are needed before developing a first prototype. It is crucial to use the right methods for the data gathering and adjust them to the target that needs to be approached. Some methods are not suitable, for example, when the target group has little experience with the system to be developed it is preferred to conduct a focus group instead of a face-to-face interview. During a focus group participants can formulate opinions by discussing the opinions of others.

Determine budget and time before starting the development process
At the start of the development process it is important to have rough estimates of the time schedule and budget available. At this early stage of the design process it is rather difficult to determine the time schedule and budget, only rough estimates are possible. However, this rough estimates give some direction and make it possible to make an inventory of the possibilities. This fastens the decision process during the development process.

Start with implementing and evaluating the core requirements
It is recommended to develop a first prototype that includes the core requirements and to obtain feedback from the potential users. When needed adjust the prototype. When the core requirements are properly implemented test which secondary requirements are of additional value. This can be done by trying stepwise the effects of additional requirements and obtain feedback from the potential users. Overall user-centered design is an iterative process, but it is also important that not too many requirements and functionalities are implemented in a prototype at a time. In other words do not try too fast to develop a serious game for real use, but try several options. In the end it will be less time and cost consuming because the change on a complete redesign decreases. Additionally, a disadvantage of developing a prototype is that already a selection is made in requirements. By developing a basis prototype and trying which secondary functionalities are of additional value it is possible to try more functionalities. Instead when developing directly a prototype for real use.

Involve the potential users and stakeholders during the development process
Ask for feedback from potential users and stakeholders. Especially, because this research has shown that there is an interest for the game by the experts and the recommended to incorporate the game into the treatment program. Therefore it is important that the game meets the requirements and functionalities that are important for the stakeholders as well as the potential users.

Develop two prototypes
Because of the differences it is recommended to develop two different prototypes. It should be noted that there are also resemblances between both groups, therefore it is also possible to develop two prototypes with the same basis. For example, the basis could be a Gamebike and the game could be adjusted to the requirements and functionalities that are preferred by the target group.

An example of a prototype for young adults
For the younger adults it is recommended to develop a prototype for an exergame that enhances intense physical activity. A game for the Gamebike is an example. Before the game starts the player enters personal data. After entering personal data the player gets an overview of his health status. The player can choose whether he will set goals or whether he wants advice before he sets goals. After goal setting the game can begin. It is recommend to use a camera in order for the player to be visible in the game. When this is not possible the player can create his own character after entering personal goals.
The screen shows a health meter which provides information about burnt calories and when possible, energy expenditure and heart rate. During the game the player will be guided by a coach. It is not necessary that the coach is visible. Also, during the game the player needs to gather ingredients by sprinting towards an ingredient that appears at unpredicted moments in the game. Afterwards the player gets an overview of his performance and multiple recipes based on the ingredients gathered during the game. The player can choose between recipes and gets information about the recipe regarding, calories and nutrition values.

The visual design needs to be realistic but not to detailed. The game environment needs to be something that is comparable to a daily environment. Therefore it is recommended to chose a realistic location to cycling. For example a park, the woods or a city.

An example of a prototype for diabetes patients

For type 2 diabetes patients it is much more important to provide information. Also, they were not convinced of the idea of a serious game. The visual design needs to be clear and clarifying. Therefore it is recommended to develop a prototype for a simulation game. In addition it is recommended to develop a simulation game that can be used as part of the treatment.

Type 2 diabetes patients indicated that they are less motivated to be physical active, therefore it is recommended to do this part at the care setting. The game can be connected to one of the fitness devices. It is recommended that the player performs moderate physical activity.

The game starts with an expert (internist, dietitian, physiotherapist) that gives a short introduction about diabetes and explanation of the simulation. After the introduction the player can choose between more information about the game or starting the game. When the player chooses for playing the game, first personal data will be entered. This will be the same as for younger adults. Also, the player gets an overview of the health status and can choose to ask for advice. Than the player can choose the difficulty level of the session. During the physical activity the player gets information about burnt calories and when possible, energy expenditure and heart rate. After the exercise the player gets an overview of his performance and his position related to the goals.

For the part that will be performed at home it is recommend to focus mainly on nutrition and on aspects related to the disease. This session starts again with an introduction about the first game that will be played.

This first game can be a TV quiz in which the player needs to answer several questions. The questions will be asked by a quiz master and after answering a question an experts (depends on the question which expert this will be) gives an short explanation regarding to the question. The player can ask for more information when needed. It is recommended to base the TV show on the background of an existing TV program, like 1 against 100. It is important that the environments is as realistic as possible therefore it is recommended to use real persons that give advice in short films. This will increase the credibility.

To enhance physical activity the player wins a cycle or hiking path, which the player can choose. The players enters which length, location and difficulty level of the path is preferred. The player can print the path and walk or cycle whenever he wants.

The combination of doing things during the game and win things that can be done at home or outside, increases the transferability.

References

1. Agenval, R., Prasad, J. (1997). The Role of Innovation Characteristics and Perceived Voluntariness in the Acceptance of Information Technologies. *Decisions Sciences,* 28 (3), 557-582.

2. Anderson, E. S., Richard, E.D., Winett, A., Wojcik, J.R., Winett, S.G., Bowden, T. (2001). A Computerized Social Cognitive Intervention for Nutrition Behavior: Direct and Mediated Effects on Fat, Fiber, Fruits, and Vegetables, Self-Efficacy, and Outcome Expectations Among Food Shoppers. *Annals of Behavioral Medicine*, 23 (2), 88–100.

3. Baarda, D.B., Goede, M.P.M. de (2006). *Methoden en technieken* (4th ed.). Groningen: Wolters-Noordhoff.

4. Babbie, E. (2004). *The practice of social research* (10th ed.). Belmont, CA: Thomson/Wadsworth.

5. Baranowski, T., Baranowski, J., Cullen, K.W., Marsh, T., Islam, N., Zakeri, I., Honess-Morreale, L., deMoor, C. (2003). Squire's Quest! Dietary Outcome Evaluation of a Multimedia Game. *American Journal of Preventive Medicine*, 24 (1), 52-61.

6. Baranowski, T., Buday, R., Thompson, D.I., Baranowski, J. (2008). Playing for Real: Video Games and Stories for Health-Related Behavior Change. *American Journal of Preventive Medicine,* 34(1), 74–82.

7. Bates, B. (2004). *Game design*. Boston: Thomson Course Technology.

8. Burnet, D.L., Elliott, L.D., Quinn, M.T., Plaut, A.J., Schwartz, M.A., Chin, M.H. (2005). Preventing Diabetes in the Clinical Setting. *Journal of General Internal Medicine,* 21, 84–93.

9. Costikyan, G. *I have no Words & I Must Design: Toward a Critical Vocabulary for Games.* Retrieved on November 21, 2008, from: http://costik.com/nowords.html#What_is

10. Crawford, C. (1982). *The art of Computer Game Design.* Retrieved from: http://www.vancouver.wsu.edu/fac/peabody/game-book/Coverpage.html

11. Creed, C. (2006). Using Computational Agents to Motivate Diet Change. *Lecture Notes in Computer Science*, 3962, 100–103. Retrieved from: http://www.springerlink.com/content/l7mr283483236564/fulltext.pdf

12. Diabetes Vereniging Nederland (a) (2008) Retrieved on November 21, 2008, from http://www.dvn.nl/nieuws/diabetesnieuws/snelle-toename-diabetes-in-eu-landen.aspx

13. Diabetes Vereniging Nederland (b) (2008) Retrieved on November 21, 2008, from http://www.dvn.nl/kenniscentrum/wat-is-diabetes.aspx).

14. Eden, K.B., Orleans, C.T., Mulrow, C.D., Pender, N.J., Teutsch S.M. (2002). Does Counseling by Clinicians Improve Physical Activity? A Summary of the Evidence for the U.S. Preventive Services Task Force. *Annals of Internal Medicine*, 137 (3), 208-215.

15. Edwards, W.K., Bellotti, V., Dey, A.K., Newman, M.W. (2003). Stuck in the Middle: The Challenges of User-Centered Design and Evaluation for Infrastructure. *Paper/Short Talks: Issues in Software Development,* 5(1), 297-304

16. Egenfeldt-Nielsen, S. (2007). Educational Potential of Computer Games. London: Continuum.

17. Egenfeldt Nielsen, S. (2005). *Beyond Edutainment: Exploring the educational potential of computer games.* Copenhagen: IT-University.

18. Elley, C.R., Kerse, N., Arroll, B., Robinson, E. (2003). Effectiveness of counseling patients on physical activity in general practice: cluster randomised controlled trial. *BMJ*, 326, 793-798.

19. Entertainment Software Association (2009). Retrieved on March 13, 2009, from http://www.theesa.com/facts/index.asp.

20. Epstein, L.H., Beecher, M.D., Graf, J.L., Roemmich, J.N. (2007). Choice of Interactive Dance and Bicycle Games in Overweight and Nonoverweight Youth. *Annals of Behavioral Medicine*, 33 (2), 124-131.

21. Glanz, K., Rimer, B. (2008). Health behavior and health education: theory, research and, practice. San Francisco, CA : Jossey-Bass.

22. Graves, L., Stratton, G., Ridgers, N.D., Cable, N.T. (2008). Energy expenditure in adolescents playing new generation computer games. *British Journal of Sports Medicine*, 42, 592-594.

23. Graves, L.E.F., Ridgers, N.D., Stratton, G. (2008). The contribution of upper limb and total body movement to adolescents' energy expenditure whilst playing Nintendo Wii. *European Journal of Applied Physiology*, 104, 617-623.

24. Greenbaum, T.L. (2000). Moderating focus groups: a practical guide for group facilitation. Thousand Oaks, CA: Sage.

25. Harteveld, C., Guimarães, R., Mayer, I.S. Bidarra, R. (2009)**.** *Balancing Pedagogy, Game, and Reality. The Design Philosophy of LEVEE PATROLLER.* Sage Publications, not published yet.

26. Hesse, B.W., Schneiderman, B. (2007). eHealth Research from the User's Perspective. *American Journal of Preventive Medicine*, 32 (5), 97–103.

27. Heijden, H. v.d. (2004). User Acceptance of Hedonic Information Systems. *MIS Quarterly*, 28 (4), 695-704.

28. Huizingh, E. (2004). *Inleiding Spss 12.0 voor Windows en Data Entry*. Den Haag: Academic Service

29. Huss, K., Winkelstein, M., Nanda, J., Naumann, P.L., Sloand, E.D., Huss, R.W. (2003). Computer Game for Inner-city Children Does Not Improve Asthma Outcomes. *Journal of Pediatric Health Care*, 17 (2), 72-78.

30. Kato, P.M., Cole, S.W., Bradlyn, A.S., Pollock, B.H. (2008). A Video Game Improves Behavioral Outcomes in Adolescents and Young Adults With Cancer: A Randomized Trial. *Pediatrics*, 122 (2), e305-e317.

31. Kinzie, M.B., Cohn, W.F., Julian, M.F., Knaus, W.A. (2002). A User-centered Model for Web Site Design: Needs Assessment, User Interface Design, and Rapid Prototyping. *Journal of the American Medical Informatics Association,* 9, 320–330. DOI 10.1197/jamia.M0822.

32. Kranenburg, K. v., Slot, M., Staal, M., Leurdijk, A., Burgmeijer, J. (2006). *Serious gaming: onderzoek naar knelpunten en mogelijkheden van serious gaming.* TNO (rapport 33866). Retrieved from http://www.tno.nl/content.cfm?context=markten&content=publicatie& laag1=182&laag2=1&item_id=132

33. Kristal, A.R., Curry, S.J., Shattuck, A.L., Feng, Z., Li, S. (2000). A Randomized Trial of a Tailored, Self-Help Dietary Intervention: The Puget Sound Eating Patterns Study. *Preventive Medicine,* 31 (4), 380-389.

34. Lanningham-Foster, L., Foster, R.C., McCrady, S.K., Jensen, T.B., Mitre, N., Levine, J.A. (2009). Activity-Promoting Video Games and Increased Energy Expenditure. *The Journal of Pediatrics*, 154 (6), 819-823.

35. Leemkuil, H. (2006). *Is it all in the game?* Thesis Twente University

36. Lieberman, D.A. (2001). Management of Chronic Pediatric Diseases with Interactive Health Games: Theory and Research Findings. *Journal of Ambulatory Care Management*, 24 (1), pp. 26-38.

37. Marcus, B.H., Owen, N., Forsyth, L.H., Cavill, N.A., Fridinger, F. (1998). Physical Activity Interventions Using Mass Media, Print Media, and Information Technology. *American Journal of Preventive medicine*, 15(4), 362–378.

38. Mauro, A., Quirós, de, F.G.B. (2009). Patient-Centered E-Health Design. In: Wilson, E.V. (Ed.). *Patient-Centered E-Health.* Hersey, NY: Medical information Science Reference.

39. McKay, H.G., King, D., Eakin, E.G., Seeley, J.R., Glasgow, R.E. (2001). The Diabetes Network Internet-Based Physical Activity Intervention: A randomized trial*. Diabetes Care,* 24, 1328–1334.

40. Miles, J., Gilbert, P. (2005). A Handbook of research methods for clinical & health psychology. Oxford: Oxford University.

41. Miles, A., Rapoport, L., Wardle, J., Afuape, T., Duman, M. (2001). Using the mass-media to target obesity: an analysis of the characteristics and reported behavior change of participants in the BBC's 'Fighting Fat, Fighting Fit' Campaign. *Health Education Research,* 16 (3), 357-372.

42. Morgan, D.L. (1998). *The focus group guidebook*. Thousand Oaks, CA: Sage.

43. Munguba, M.C., Valdes, M.T.M., da Silva, C.A.B. (2008). The application of an occupational therapy nutrition education programme for children who are obese. *Occupational Therapy International*, 15 (1), 56-70.

44. Nijland,N., Seydel,E.R., Gemert-Pijnen,van, J.E.W.C., Brandenburg, B., Kelders,S.M., Will,M. (2009). Evaluation of an Internet-Based Application for Supporting Self-Care of Patients with Diabetes Mellitus Type 2, etelemed, pp.46-51, 2009 International Conference on eHealth, Telemedicine, and Social Medicine.

45. Ni Mhurchu, C., Maddison, R., Jiang, Y., Jull, A., Prapavessis, H., Rodgers, A. (2008). Couch potatoes to jumping beans: A pilot study of the effect of active video games on physical activity in children. *International Journal of Behavioral Nutrition and Physical Activity*, 5, 8-12.

46. Oenema, A., Brug, J., Lechner, L. (2001). Web-based tailored nutrition education: results of a randomized controlled trail. *Health Education Research,* 16 (6), 647-660

47. Oenema, A., Tan, F., Brug, J. (2005). Short-Term Efficacy of a Web-Based Computer-Tailored Nutrition Intervention: Main Effects and Mediators. *Annals of Behavioral Medicine*, 29 (1), 54–63.

48. Peng, W. (2009). Design and Evaluation of a Computer Game to Promote a Healthy Diet for Young Adults. *Health Communication*, 24 (2), 115-127.

49. Prensky, M., (2002). The Motivation of Gameplay or, the REAL 21st century learning revolution. *On The Horizon*, 10 (1). Retrieved from: http://www.marcprensky.com/writing/default.asp

50. Prensky, M., (2003). Digital game-based learning. ACM Computers in entertainments, 1 (1).

51. Rijksinstituut voor Volksgezondheid en Milieu (2009). Retrieved on March 10, 2009, from http://www.rivm.nl/vtv/object_document/o1254n18950.html (a) http://www.rivm.nl/vtv/object_document/o1252n18950.html (b) http://www.rivm.nl/vtv/object_document/o1259n17502.html (c)

52. Rouck, de, S., Jacobs, A., Leys, M. (2007). A methodology for shifting the focus of e-health support design onto user needs A case in the homecare field. *International journal of medical informatics,* 77, 589–601.

53. Salen, K., Zimmerman, E. (2004). *Rules of Play, Game Design Fundamentals*. Cambridge, MA: The MIT Press.

54. Silverman, B.G., Holmes, J., Kimmel, S., Branas, C. (2002). Computer Games May Be Good For Your Health. *Journal of Healthcare Information Management*, 16 (2), 80-85.

55. Skinner, H.A., Maley, O., Norman, C.D. (2006). Developing Internet-Based eHealth Promotion Programs: The Spiral Technology Action Research (STAR) Model. *Health Promotion Practice*, 7 (4), 406-417.

56. Skogland, N.V. (2007). An evaluation of the effectiveness of an educational intervention on the severity of pediatric asthma. Thesis Florida State University.

57. Sun, H., Zhang, P. (2006). The role of moderating factors in user technology acceptance. *International Journal of Human-Computer Studies*, 64 (2), 53-78.

58. Susi T., Johannesson, M., Backlund P. (2007). *Serious Games – An Overview.* University of Skövde (Technical Report HS- IKI -TR-07-001). Retrieved from: http://www.autzones.com/din6000/textes/semaine12/SusiEtAl(2005).pdf

59. Thompson, D., Baranowski, T., Buday, R., Baranowski, J., Juliano, M., Frazior, M., Wilsdon, J., Jago, R. (2007). In Pursuit of Change: Youth Response to Intensive Goal Setting Embedded in a Serious Video Game. *Journal of Diabetes Science and Technology*, 1 (6), 907-917.

60. Velde, R. te, Brennenraedts, R., Kaashoek B., Segers J. (2007). Serious Games: Sectoroverstijgende technologie- en marktverkenning. Onderzoeksbureau

Dialogic, innovatie & interactie. Retrieved from:
http://appz.ez.nl/bestel/toon.asp?id=07et09

61. Waller, A., Franklin, V., Pagliari, C., Greene, S. (2006). Participatory design of a text message scheduling system to support young people with diabetes. *Health Informatics Journal,* 12 (4), 304-318.

62. Warburton, D.E.R., Bredin, S.S.D., Horita, L.T.L., Zbogar, D., Scott, J.M., Esch, B.T.A., Rhodes, R.E. (2007). The health benefits of interactive video game exercise. *Applied Physiology, Nutrition, and Metabolism*, 32 (4), 655-663.

63. Watters, C., Oore, S.,Shepherd, M., Abouzied, A., Cox, A., Kellar, M., Kharrazi, H., Liu, F., Otley, A. (2006). Extending the Use of Games in Health Care*. Proceedings of the 39th Hawaii International Conference on System Sciences 2006*, 5, 88b-88b.

64. Wilson, E.V. (2008). *Patient-Centered Design.* New York, NY: Medical Information Science Reference.

65. Zyda, M. (2005). *From Visual Simulation to Virtual Reality to Games.* IEEE Computer Society. Retrieved from: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1510565

List of abbreviations

DVN Diabetes Vereniging Nederland
ESA Entertainment Software Association
FyZoB Fysiotherapeuten Zuid-Oost Brabant
HR Heart Rate
PoZoB Praktijkondersteuning Zuid-Oost Brabant
RIVM Rijksinstituut voor Volksgezondheid en Milieu
SCT Social Cognitive Theory
UCD User-Centered Design

List of tables, figures, and sources

List of tables

List of figures

List of sources

Figure 5:   http://g-ecx.images-amazon.com/images/G/01/videogames/detail-
            page/B001MBUGLY.02.lg.jpg
Figure 6:   http://media.photobucket.com/image/making%20character%20wii/jdpulliam/Mii.jpg
Figure 7:   http://gamers-globe.com/images/screenshots/eyetoy-play-3/eyetoy-play-3-ps2-019.jpg
Figure 8:   http://nutritiondecision.org
Figure 9:   http://xkcd.com/
Figure 10: http://www-03.ibm.com/press/us/en/presskit/21550.wss

Appendix A: Systematic PubMed search

First search criteria	Second search criteria	Number of results
Serious game	Health	32
OR Interactive game		88
OR Videogame		403
	OR health care	426
	OR Health promotion	426 -> 0 new-> removed
	OR eHealth intervention	426 ->removed
	OR Prevention	526
	OR behavior	940
	OR behaviour	940 -> removed
	OR Physical activity	982
	OR Sedentary lifestyle	983
	OR Nutrition	983 ->removed
	OR eating habits	984
	OR overweight	986
	OR weight	1001
	OR obesity	1004
	OR motivation	1033
	OR adherence	1033-> removed
	OR lifestyle	1036
	OR diabetes	1038
	OR chronic disease	1042
	OR asthma	1046
	OR education	1142
	OR elearning	1142->removed
Total without limits		1142
limits		
	Publishing date after 2000	860
	Language English (818) or Dutch (0)	818
Total with limits		818
Futher selection		
	Based on title	48
	Based on abstract	19
	Based on content	14
Final selection		

Final search term including limitations
(serious game OR interactive game OR video game) AND (health OR health care OR health prevention OR behavior OR physical activity OR sedentary lifestyle OR eating habits OR overweight OR weight OR obesity OR motivation OR lifestyle OR diabetes OR chronic disease OR asthma OR education) AND (("2000"[PDat] : "3000"[PDat]) AND (English[lang] OR Dutch[lang]))

Appendix B: Questionnaire survey

Vragenlijst games ter ondersteuning bij leefstijlverandering

Ter afsluiting van mijn studie Gezondheidswetenschappen aan de Universiteit Twente voer ik een onderzoek uit naar de mogelijkheden voor computerspelletjes bij het ondersteunen van leefstijlverandering. Dit onderzoek wordt uitgevoerd in opdracht van Medicinfo, een innovatiecentrum gevestigd in Tilburg. De vragenlijst bestaat uit vijf vragen en tien stellingen. Het invullen van vragenlijst zal ongeveer vijf minuten van uw tijd kosten.

Alle gegevens die u invult worden anoniem verwerkt en alleen gebruikt voor het onderzoek. Alvast bedankt voor uw deelname!

Met vriendelijke groet,
Arnica Wijers

1. Wat is uw geboortedatum?

   <u>dd</u> / <u>mm</u> / <u>jjjj</u>

2. Wat is uw geslacht?
   o Man
   o Vrouw

3. Wat is uw hoogst genoten opleiding?
   o Lagere school
   o LBO, LAVO, LEAO
   o HAVO, VWO
   o HEAO, HTS, HBO
   o Universiteit
   o Anders, namelijk:

4. Speelt u wel eens computergames?
   o Ja, 1 of 2 keer per maand
   o Ja, 3 of 4 keer per maand
   o Ja, 1 of 2 keer per week
   o Ja, 3 of 4 keer per week
   o Ja, 5 of 6 keer per week
   o Ja, dagelijks
   o Nee (ga door naar vraag 8)

5. Wat voor type computergames speelt u het liefst?
    o Adventure games
    o Strategy games
    o Action games
    o Educatieve games
    o Role playing games
    o Puzzels
    o Anders namelijk:

    ┌─────────────────────────────────┐
    │   │
    │   │
    └─────────────────────────────────┘

6. De volgende vragen gaan over de rol van computergames en het veranderen van leefstijl. Leefstijlverandering houdt in dit geval in gezond eten en voldoende bewegen.
Geef bij elke uitspraak aan in hoeverre u het met de stelling eens bent.

• Een computergame kan mensen helpen bij het veranderen van leefstijl.

    Helemaal eens   eens   oneens   helemaal oneens

• Een computergame met als doel leefstijlverandering, zou ik wel willen uitproberen.

    Helemaal eens   eens   oneens   helemaal oneens

• Een computergame met als doel leefstijlverandering moet er realistisch uit zien.

    Helemaal eens   eens   oneens   helemaal oneens

• Een computergame met als doel leefstijlverandering moet mooi geïllustreerd zijn (van hoge grafische kwaliteit zijn).

    Helemaal eens   eens   oneens   helemaal oneens

• Een computergame met als doel leefstijlverandering moet met meerdere spelers gespeeld kunnen worden (twee of meer spelers die na elkaar spelen).

    Helemaal eens   eens   oneens   helemaal oneens

• Een computergame met als doel leefstijlverandering moet **online** met meerdere spelers **tegelijk** gespeeld kunnen worden.

    Helemaal eens   eens   oneens   helemaal oneens

- Een computergame met als doel leefstijlverandering moet op een persoon worden afgestemd voor het stellen van persoonlijke doelen .

  Helemaal eens   eens   oneens   helemaal oneens

- Een computergame met als doel leefstijlverandering moet overal gebruikt kunnen worden (denk hierbij aan de Gameboy en de Nintendo DS, die zijn klein en makkelijk mee te nemen, zie bijlage).

  Helemaal eens   eens   oneens   helemaal oneens

- Een computerspel met als doel leefstijlverandering moet vooral informatief zijn.

  Helemaal eens   eens   oneens helemaal oneens

- Een computerspel met als doel leefstijlverandering moet vooral actief gespeeld worden (denk hierbij aan de Wii Fit, zie bijlage).

  Helemaal eens   eens   oneens   helemaal oneens

- Dit is het einde van de vragenlijst. Hartelijk dank voor uw bijdrage-

Bijlage 1: Afbeeldingen van de Gameboy, de Wii Fit en de Nintendo DS

Appendix C: Questionnaire structured interviews

Start to run

In 2006 is Vlaanderen Sportland een actie gestart, waarbij je hardlooplessen kan downloaden voor op je mp3 speler. De lessen worden begeleidt door Evy Gruyaert. De trainingsduur varieert per les tussen de 18 minuten en 32 minuten. Het doel van de trainingen is om in 30 lessen (3 per week) uiteindelijk 5 km onafgebroken te hardlopen in een half uur.
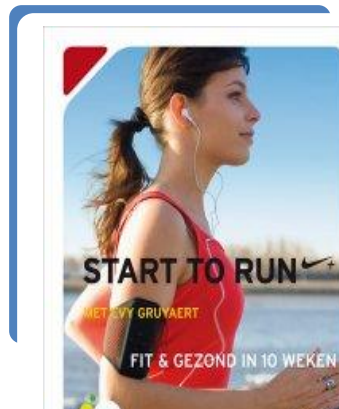
Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Een coach geeft precies aan wanneer je moet wandelen en wanneer je moet hardlopen. Ondertussen wordt de muziek aangepast aan het looptempo.	
Het niveau begint heel laag maar neemt langzaam toe.	
Je krijgt tijdens de training allerhande tips rond schoenen, kleding, voorkomen van blessures en gezonde voeding.	
Je krijgt complimentjes voor het volhouden van de les.	

Nike + Ipod

Ipod heeft in samenwerking met een Nike een Sport Kit ontwikkeld bestaande uit een Ipod, een paar Nike+-schoenen en de Nike + iPod Sport Kit of Sensor. De sensor legt alle gegevens van je hardloopsessie vast en stuurt de gegevens naar je iPod.

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je kunt een trainingssessie kiezen in het Nike + iPod-menu en zelf instellen op basis van trainingstijd, aantal te verbranden calorieën, of afstand. Maar je kunt ook een trainingssessie met een "open einde" instellen.	
Je kunt je eigen achtergrondmuziekje instellen d.m.v. een afspeellijst, willekeurige nummers of door Nike samengestelde Sport Music.	
Tijdens het lopen informeert je iPod je over de verstreken tijd, de gelopen afstand, je tempo en het aantal verbrandde calorieën.	
Je kunt je trainingsgegevens bekijken op de nikeplus site. Op die site vind je alle trainingen terug.	
Je kunt via de site informatie uitwisselen met collega-hardlopers.	

GameBike

De speler fietst op een hometrainer met spelbesturing voor een PlayStation2, waardoor men zelf deelneemt aan het spel op het scherm. Het fietsen is de motor voor het spel, dus er moet flink getrapt worden om te kunnen spelen. Vrijwel alle games waarbij een voertuig bestuurd wordt, zijn geschikt voor de GameBike.

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je kunt het met twee spelers spelen.	
Het spel speelt zich af in een virtuele omgeving.	
De omgeving is realistisch.	
Het is intensief. Je hebt echt het gevoel gesport te hebben.	
Jij bepaalt hoe hard de fietser gaat.	

LaserSquash

Bij laser squash worden laserstralen op je afgevuurd en is het de bedoeling om zoveel mogelijk stralen te raken met een laserstick. Het spel wordt toegepast in attractiecentra, lasergamecentra, fitnesscentra, binnenspeelplaatsen en bij bedrijven als kantoorsport.

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je moet snel reageren en veel bewegen tijdens dit spel.	
Je speelt het spel met twee personen.	
Een ronde duurt twee minuten, hierdoor is het mogelijk om met een groep te spelen. Je kunt elkaar namelijk snel afwisselen.	
De scores worden digitaal bijgehouden.	
De spelomgeving is futuristisch.	
Je kunt verschillende niveaus instellen.	
Als je erg snel bent dan krijg je een snelheidsbonus.	

Wii fit

De Wii fit is ontworpen om je bewuster te laten zijn van je fysieke conditie, terwijl je tegelijkertijd plezier hebt en een beetje gezonder kunt worden. De Wii fit bestaat uit een balance board en een spelcomputer met meer dan 40 oefeningen om je te helpen bij het verbeteren van je balans, houding en BMI.
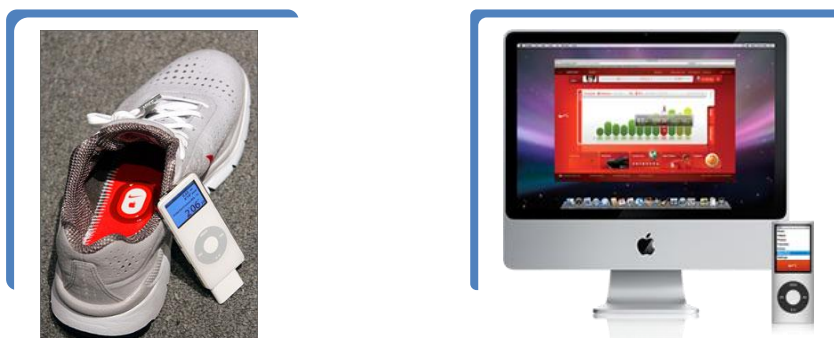

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je kunt je eigen gegevens invoeren en op basis van die gegevens wordt je BMI bepaald en kun je en een leeftijdsanalyse doen.	
Door te weten wat je startpositie is kun je jezelf doelenstellen, zoals het verlagen van je BMI.	
Je kunt oefeningen samen met anderen doen.	
Je kunt je eigen karakter maken.	
Er worden high scores bijgehouden.	

Het is redelijk intensief.	
Je houdt zelf de controle door middel van het balance board.	
De spelomgeving is realistisch.	
De vormgeving ziet er goed uit.	
Je kunt andere spelers uitdagen.	

Eye toy

De EyeToy is een aansluitbare digitale kleurencamera, vergelijkbaar met een webcam, voor de Playstation 2 en de Playstation Portable. Deze technologie laat de speler zelf in het spel meespelen.

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je zit zelf letterlijk in het spel.	
Je kunt het spel samen met anderen spelen.	
Je moet redelijk in beweging komen.	
Het spel is onrealistisch.	

Nutrition decision

Nutrition decision bestaat uit een aantal kleine games waarbij je leert om etiketten te lezen op voedingsproducten. Eerst wordt een uitleg gegeven en daarna word je getest aan de hand van vragen over het geleerde. Je krijgt een etiket en je moet bijvoorbeeld aangeven waar je kunt vinden hoeveel vet het product bevat en wat dat voor gevolgen heeft voor je lichaam. Daarnaast leer je welke hoeveelheden natrium, vezels, (on)verzadigd vet, etc. goed voor je zijn, hoe je de hoeveelheid calorieën kunt bepalen, de aanbevolen dagelijkse hoeveelheid, etc. Je krijgt meerkeuzevragen en je moet het juiste antwoord aanklikken.

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je leert welke voedingsmiddelen belangrijk zijn, welke informatie er op etiketten van voedingsmiddelen staan en hoe je kunt bepalen welke voeding gezond is.	
Vind je het leuk dat de vaardigheden die je leert tijdens het spel herhaalt worden?	
Je krijgt meerkeuze vragen over de kennis die je hebt opgedaan.	
Je speelt het spel alleen.	

Cooking guide Nintendo DS

Dit spel is verkrijgbaar op de Nintendo DS. Je wordt tijdens het koken begeleidt door een virtuele kok die je aanwijzingen geeft tijdens het koken. Je houdt je handen tijdens het koken vrij, want de Nintendo DS reageert op je stemgeluid. Alle handelingen worden duidelijk uitgelegd, maar het is mogelijk om meer details te vragen.
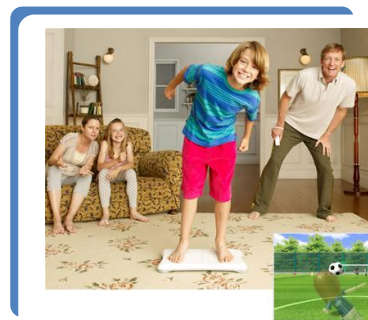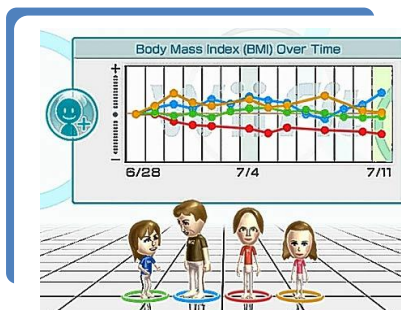

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je wordt begeleid door een virtuele kok.	
Je kunt instructiefilmpjes bekijken en om meer details vragen.	
Je leert verschillende maaltijden te bereiden in je eigen keuken met de hulp van een virtuele kok	
Je kunt recepten kiezen op basis van moeilijkheidsgraad, bereidingstijd, aantal calorieën, kookmethoden en ingrediënten.	
De spelomgeving is realistisch.	

Cooking mama Nintendo DS

Dit spel kun je spelen op de Wii. Je gebruikt de afstandsbediening als keukengereedschap. Dit spel laat je niet alleen het recept lezen, maar ook uitvoeren. Hiermee kun je je kookkunsten verbeteren.
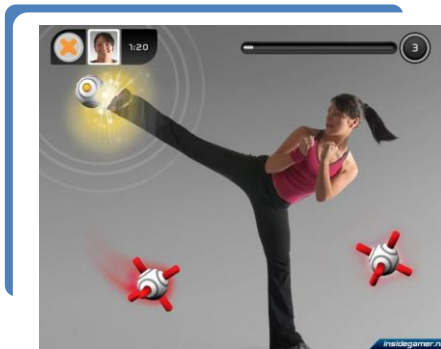

Deze toepassing bestaat uit een aantal elementen die in de onderstaande tabel onder elkaar zijn gezet. Kruis in deze tabel aan welke elementen je het meest aanspreken:

Je leert recepten te bereiden in een virtuele keuken.	
Je kunt recepten uitwisselen.	

Extra vragen:

1. Als jij je leefstijl zou willen veranderen met behulp van een computerspel dan moet dat betrekking hebben op:
   A) Voeding
   B) Beweging
   C) Voeding en Beweging

2. Hoe moet het spel aangeboden worden? Op een:
   A) PC
   B) game console
   C) draagbare computer (gameboy, Nintendo DS)
   D) mobiele telefoon

Brainstorm

1. Als jij je leefstijl zou willen veranderen met behulp van een computerspel hoe zou de spelomgeving eruit moeten zien?

2. Hoe zou het karakter eruit moeten zien?

3. Wat zou het karakter moeten kunnen doen?

Appendix D: Questionnaires focus group

The Great Flu

The Great Flu gaat over het uitbreken van een pandemie. Er is sprake van een pandemie wanneer een besmettelijke ziekte, zoals de Mexicaanse griep, zich zeer snel verspreidt en veel doden veroorzaakt. In het spel The Great Flu is het de bedoeling dat u door middel van strategische beslissingen voorkomt dat er een pandemie uitbreekt. Door middel van krantenberichten wordt u in het spel op de hoogte gehouden van de stand van zaken. Op basis van deze berichten moet u beslissen welke middelen u in gaat zetten om een pandemie te voorkomen. In het spel word u behoorlijk onder druk gezet, want u ziet het aantal geïnfecteerde mensen met de seconde stijgen.

Vragen

Vraag 1: Vindt u het leuk om in een computerspel strategische beslissingen te nemen, zoals in het spel The Great Flu?
 	
   o   Ja
   o   Nee
   o   Weet niet

Vraag 2: Vindt u het leuk om in een computerspel beslissingen onder tijdsdruk te nemen?
   o   Ja
   o   Nee
   o   Weet niet

Vraag 3: In the Great Flu moet u beslissingen nemen waarbij u niet direct ziet wat het effect is van uw beslissing. Vindt u dit vervelend en zou u liever direct resultaat zien in het spel?
   o   Ja
   o   Nee
   o   Weet niet

Quest for the Code

Quest for the Code bestaat uit een aantal kleine spelletjes die te maken hebben met astma. De spellen leren u hoe u om kunt gaan met de ziekte, hoe klachten ontstaan, wat u eraan kunt doen, etc. Als u onvoldoende informatie heeft om de opdracht uit te voeren, kunt u extra informatie opvragen.

Vragen

Vraag 4: Zou u het leuk vinden om door middel van "schuif-opdrachten" meer te weten te komen over voeding en bewegen?
 	
   o   Ja
   o   Nee
   o   Weet niet

Vraag 5: Zou u het handig vinden als u extra informatie kan vragen tijdens het spel?
 	
   o   Ja
   o   Nee
   o   Weet niet

Nutrition Decision

Nutrition Decision is een spel dat bestaat uit allerlei kleine spelletjes waarbij u geleerd wordt welke informatie er op etiketten van voedingsmiddelen staan, in welke hoeveelheden voedingsstoffen gezond zijn en hoe u de voedingswaarden kunt bepalen van verschillende porties.

Vragen

Vraag 6: Vindt u het leuk als het computerspel uit allemaal kleine spelletjes bestaat?
 	
   o   Ja
   o   Nee
   o   Weet niet

Vraag 7: Vindt u het leuk dat de handeling die u uit moet voeren (het juiste antwoord aanklikken) herhaald wordt?
 	
   o   Ja
   o   Nee
   o   Weet niet

Vraag 8: Vindt u het leuk om op deze manier meer informatie te krijgen over voeding?
 	
   o   Ja
   o   Nee
   o   Weet niet

Re-Mission

Re-Mission is speciaal ontwikkeld voor jongeren en jong volwassenen met kanker. In het spel bestuurt de speler Roxxi, een robot. Zij reist door het lichaam van een kankerpatiënt. In het spel wordt u bijgestaan door Smitty, ook een robot, die vertelt wat de patiënt heeft, hoe de ziekte precies verloopt, wat de neveneffecten zijn van de behandeling, etc. Roxxi moet in het spel kankercellen vernietigen, bacteriële infecties te lijf gaan en leren om te gaan met de neveneffecten van de behandeling.

Vragen

Vraag 9: Vindt u het leuk om in een spel begeleid te worden door een virtuele gids, zoals Smitty in het spel Re-mission?
 	
   o Ja
   o Nee
   o Weet niet

Vraag 10: Vindt u het belangrijk om in het spel problemen die gerelateerd zijn aan uw ziekte op te lossen?
 	
   o Ja
   o Nee
   o Weet niet

Vraag 11: Vindt u het belangrijk dat het spel zich in het lichaam afspeelt?
 	
   o Ja
   o Nee
   o Weet niet

Vraag 12: In een computerspel kunt u op verschillende manieren op de hoogte gehouden worden van uw prestaties. Vindt u het belangrijk dat u via een virtuele gids *tijdens* het spel op de hoogte wordt gehouden van uw vooruitgang in het spel, of wilt u dit liever *na* het spel via een virtuele coach?
Het liefst wil ik als volgt op de hoogte gehouden worden van mijn prestaties:
 	
   o ***Tijdens*** het spel, via een virtuele gids
   o ***Na*** het spel, via een virtuele gids
   o Anders, namelijk………………………………
   o Weet niet

Innov8

Innov8 is een computerspel waarin bedrijfsprocessen worden gesimuleerd. In het spel leert u hoe bedrijfsprocessen werken en hoe u deze kunt verbeteren.

U kiest aan het begin van het spel een bepaalde afdeling van het bedrijf uit, bijvoorbeeld de klantenservice. U krijgt eerst een filmpje te zien welke processen er plaatsvinden op deze afdeling en dat dit proces verbetert moet worden. Na het filmpje krijgt u het bedrijfsproces schematisch te zien en kunt u dit aanpassen. Voordat u dit gaat doen kunt u advies krijgen van verschillende experts. Dit advies krijgt u in de vorm van tekst. Op basis van dit advies kunt u het bedrijfsproces veranderen, dit doet u door te kiezen uit een aantal opties. Bij uw keuze krijgt u te horen of het de juiste keuze is en waarom. Als u de juiste keus heeft gemaakt, dan krijgt u in een filmpje te zien hoe het proces in de praktijk in zijn werk gaat.

Vragen
Vraag 13: Vindt u het prettig om informatie/advies te krijgen in de vorm van tekst? o Ja o Nee o Weet niet
Vraag 14: Vindt u het prettig om direct te zien of u de juiste keuze heeft gemaakt? o Ja o Nee o Weet niet
Vraag 15: Vindt u het prettig dat een filmpje laat zien waarom uw keuze juist is? o Ja o Nee o Weet niet
Vraag 16: Vindt u het prettig als u aan het eind van het spel een overzicht van al uw prestaties krijgt? o Ja o Nee o Weet niet

Wii Fit

De Wii Fit bestaat uit een balance board en een spelcomputer met meer dan 40 oefeningen om u te helpen bij het verbeteren van uw balans, houding en BMI (=Body Mass Index). Uw BMI wordt bepaald door uw gewicht en lengte en geeft aan of uw gewicht in balans is met uw lengte. Aan het begin van het spel voert u uw lengte en gewicht in. Op basis van deze gegevens bepaalt de computer wat uw BMI is. Hiermee kunt u zien of u overgewicht hebt of niet. Na het bepalen van uw BMI kunt u aangegeven wat u graag zou willen bereiken. Bijvoorbeeld hoeveel u wilt afvallen en op welk termijn u dit wilt bereiken. Na elke oefening ziet u of u dichterbij uw doel bent gekomen. Ook kunt u uw prestatie vergelijken met die van andere spelers.

Vragen
Vraag 17: Vindt u het prettig dat u uw eigen gegevens kunt invoeren en op basis daarvan zelf doelen kunt stellen? o Ja o Nee o Weet niet
Vraag 18: Vindt u het prettig dat u uw prestaties kunt vergelijken met die van andere spelers? o Ja o Nee o Weet niet
Vraag 19: Vindt u het prettig dat u na afloop van elke oefening kunt u zien of u dichterbij uw doel bent gekomen? o Ja o Nee o Weet niet
Vraag 20: Vindt u het prettig om dit spel samen met andere mensen te spelen? o Ja o Nee o Weet niet

Silverfit

De Silverfit bestaat uit allerlei kleine spelletjes die u kunt spelen door te bewegen. Door bijvoorbeeld op de plaats een stapbeweging te maken, beweegt u op het scherm. De bewegingen kosten weinig inspanning.

Vragen

Vraag 21: Vindt u het prettig dat u spelletjes speelt die niet direct gerelateerd zijn aan uw ziekte, terwijl u ondertussen wel bezig bent met uw gezondheid doordat u in beweging bent?
 	
   o   Ja
   o   Nee
   o   Weet niet

Vraag 22: Vindt u het prettig om juist geen informatie te krijgen met betrekking tot uw gezondheid?
 	
   o   Ja
   o   Nee
   o   Weet niet

Gamebike

De Gamebike bestaat uit een hometrainer en een spelcomputer. Door op de hometrainer te gaan fietsen kunt het spel op het scherm besturen. Op deze manier neemt u echt deel aan het spel. U moet aardig doortrappen om het spel goed te spelen. Het is mogelijk om het spel met twee personen tegelijk te spelen.

Vragen
Vraag 23: U heeft nu drie fragmenten gezien van computerspelletjes waarbij u moet bewegen om de spelletjes te kunnen spelen. De Gamebike verschilt in intensiviteit in vergelijking met de Silverfit en de Wii Fit. De Silverfit is het minst intensief, terwijl de Gamebike juist erg intensief is. De Wii Fit zit er tussenin. Als u kijkt naar de mate van intensiviteit, welk spel spreekt u dan het meest aan?   o Silverfit   o Wii Fit   o Gamebike   o Ik wil liever niet bewegen als ik een spelletje speel
Vraag 24: Vindt u het prettig dat u tegelijk met een andere speler kunt spelen, zodat er een competitie ontstaat?   o Ja   o Nee   o Weet niet

-Dit is het einde van deze vragenlijst, hartelijk dank voor het invullen. U kunt de vragenlijst bij de onderzoekster inleveren-

Appendix E: Second questionnaire focus group

Onderdeel A: Computergebruik en games

1. Beschikt u thuis over een computer?
   - o Ja
   - o Nee (ga door naar vraag 3)

2. Beschikt deze computer over een internetaansluiting?
   - o Ja
   - o Nee

3. Speelt u wel eens computergames?
   - o Ja
   - o Nee (ga door naar vraag 7)

4. Speelt u deze computergames thuis?
   - o Ja
   - o Nee
   - o Ergens anders, namelijk;……………………………………………………

5. Hoe vaak speelt u computergames?
   - o Heel vaak
   - o Regelmatig
   - o Af en toe
   - o Zelden
   - o Nooit

6. Wat voor soort computergames speelt u?
   - o Adventure games
   - o Strategy games
   - o Action games
   - o Educatieve games
   - o Puzzels
   - o Role playing games
   - o Sportgames
   - o Anders, namelijk………………………………………………………………

7. Waarom speelt u wel/geen computergames?

   …………………………………………………………………………………………………
   …………………………………………………………………………………………………
   …………………………………………………………………………………………………

8. In hoeverre denkt u dat een computergame u kan helpen bij het veranderen van uw eetgewoonten?
   - o Heel veel
   - o Veel
   - o Enigszins
   - o Minimaal
   - o Helemaal niet

9. In hoeverre denkt u dat een computergame u kan stimuleren om meer te gaan bewegen?
   - o Heel veel
   - o Veel
   - o Enigszins
   - o Minimaal
   - o Helemaal niet

Onderdeel B: Gezondheid en leefstijl

10. Hoe zou u over het algemeen uw gezondheid beoordelen?
    - o Uitstekend
    - o Zeer goed
    - o Goed
    - o Matig
    - o Slecht

11. Welke beperkingen ervaart in uw dagelijks leven vanwege uw diabetes?

    ....
    ....
    ....

12. Heeft u wel eens geprobeerd om uw eetgewoonten te veranderen?
    - o Ja
    - o Nee (ga door naar vraag 20)

13. Hoe heeft u geprobeerd om uw eetgewoonten aan te passen?

    ....
    ....
    ....

14. Wat werkte bij deze manier *wel*?

    ....
    ....
    ....

15. Wat werkte bij deze manier *niet*?

    ....
    ....
    ....

16. Heeft u wel eens geprobeerd om meer te gaan bewegen?
    - o Ja
    - o Nee (ga door naar vraag 24)

17. Hoe heeft u geprobeerd om meer te gaan bewegen?

    ....
    ....
    ....

18. Wat werkte bij deze manier **wel**?

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

19. Wat werkte bij deze manier **niet**?

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

Onderdeel C: Behandeling

20. Wordt u op dit moment behandeld voor diabetes?
    o Ja
    o Nee (ga door naar vraag 32)

21. Wat voor behandeling volgt u?
    o Dieet
    o Dieet en tabletten
    o Dieet en insuline
    o Dieet, tabletten en insuline
    o Anders, namelijk…………………………………………

Onderdeel D: Afsluitende vragen

Leeftijd:…………………………………...

Geslacht: man/vrouw

Nationaliteit:…………………………………………

Wat is uw hoogst afgeronde opleiding:
   ○ basisonderwijs;
   ○ vmbo (voorbereidend middelbaar beroepsonderwijs);
   ○ mavo (middelbaar algemeen voortgezet onderwijs, mulo);
   ○ havo (hoger algemeen voortgezet onderwijs);
   ○ vwo (voorbereidend wetenschappelijk onderwijs);
   ○ mbo (middelbaar beroepsonderwijs);
   ○ hbo (hoger beroepsonderwijs);
   ○ wo (wetenschappelijk onderwijs);
   ○ anders, namelijk…………………………………………

Welke beschrijving is het meest van toepassing op uw huidige werk- en/of levenssituatie:
   ○ betaald werk;
   ○ huisvrouw/-man;
   ○ werkloos;
   ○ arbeidsongeschikt;
   ○ gepensioneerd;
   ○ student;
   ○ anders, namelijk:…………………………………………

Heeft u verder nog opmerkingen of suggesties?

-Dit is het einde van deze vragenlijst. Hartelijk dank voor het invullen.-

Appendix F: Questionnaire open interviews

Vragenlijst interview experts

Onderdeel A: Ziekteverloop en hehandeling

1. Welke problemen komt u tegen bij de begeleiding van diabetes type 2?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

2. Wat is volgens u de oorzaak van deze problemen?

   ………………………………………………………………………………………
   ………………………………………………………………………………………....
   ………………………………………………………………………………………

3. Hoe denkt u dat patiënten te motiveren zijn om hun eetgedrag te veranderen?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

Onderdeel 2: Games als ondersteuning

4. Denkt u dat een computergame kan ondersteunen bij het veranderen van eetgewoonten/ stimuleren van meer bewegen?
   - o   Ja
   - o   Misschien
   - o   Nee

5. Waarom denkt u dat?

   ………………………………………………………………………………………
   ………………………………………………………………………………………....
   ………………………………………………………………………………………

6. Welke informatie over voeding/bewegen moet terug komen in het game?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………....

7. Hoe moet deze boodschap overgebracht worden?

   ………………………………………………………………………………………
   ………………………………………………………………………………………
   ………………………………………………………………………………………

Appendix G: Literature overview

Author(s)	N. Venger Skoglund	D.A. Lieberman	P.M. Kato, S. W. Cole, A.S. Bradlyn, B.H. Pollock	B.G. Silverman, J. Holmes, S. Kimmel, C. Branas
Reference	An evaluation of the effectiveness of an educational intervention on the severity of pediatric asthma (America, 2007)	Management of Chronic Pediatric Diseases with Interactive Health Games: Theory and Research Findings (America, 2001)	A videogame improves behavorial outcomes in adolescents and young adults with cancer:a randomize trial (America, 2004-2005)	Computer Games May Be Good For Your Health (America, 2002)
Title	Quest for the Code	Bronkie the Bronchosaurs (B), Packy and Marlon (P), and Rex Ronan (R).	Re-mission	Heart sense game
Genre	Educational	Action-adventure	Action-adventure	Role-playing
Type of game	Other behaviour change	Other behaviour change	Other behaviour change	Other behaviour change
Theory	Not reported	Social Cognitive Theory (SCT)	self-regulation model of health and illness, social cognitive theory, and learning theory.	Based on model Fishbein. Unclear which one
Change methods	Reinforcement, self-efficacy messages, modeling, rehearsal, problem-solving and decision making.	Challenge, motivation, role models, simulations, repetition, feedback	Not clear in article	create social pressure, instructionist and constructivist materials. problem- based learning, favor student-centered learning, self-discovery of clinical and behavioral insights, and personally experiencing realistic patient cases in a simulated microworld.
Game elements	Unclear	**(B)**Interactivity, decision-making, problem solving, competition, and story **(P):** Interactivity, decision-making, and story **(R):** Unclear	Interactivity , story/fantasy	Unclear
Target behavior	Better asthma control	**(B/P)** asthma/ diabetes Self-management **(R)** Attitudes	Adherence to cancer treatment	To cause a shift in user health care behavior and intention
Target group	Children (6-12 years)	children/preadolescents	Adolescents and adults (13 – 29) years	People with a high risk on a heart attack (adults)
Game intervention	Educational	Improve health outcomes	Behavioral change	Educational
Study design	Pre-test-post-test design	**(B1)**Pretest-posttest study) **(B2)** Media comparison study **(B3)**Impatient study **(P)** controlled clinical trial **(R)** pretest-posttest study	Two–arm randomized trial	Case study
Data gathering methods	Demographic data and pre/posttest recording form, Healthscan peak flow meter pre/posttest and measurements, Post-test interview form, Asthma Control Test pre/posttest, measurements Pre-test computer literacy assessment		Medication Adherence Scale, CDCI, MEMS-capmonitoring, Mixed-effect linear model analyses, Pediatric Quality of Life self-report instrument, Functional Assessment of Cancer Therapy-General, Perceived Stress Scale, Multidimensional Health Locus of Control Scale Form.	Questionnaires
Sample size	36		371	18
measures	Peak flow values, A.C.T scores.		Adherence, behaviour change outcomes	Usability

Intervention	Each participant family received an educational CD-ROM, Quest For The Code. Twice a week for one month	**(B1, P, R):**Playing the game **(B2):** Comparing the impacts of spending 30 minutes playing Bronkie with watching a professionally produced 30-minute videotape about asthma self-care, targeted to children. **(B3):** Two video game stations on rolling carts with several video games including Bronkie	All participants received a Shutlle SB51G minicomputer and were asked to play the game.	Playing the full version of the Heart Sense Game or the didactic version
Time of exposure	Twice a week	varied	1 year	
Primary outcome	Health outcomes	Health behavior change	Health outcomes and behavior change outcomes	Behavior change outcomes
Fun experience	A few parents referred to the game as "fun"	Enjoyment of two-player option	Not clear	Unclear
Results	• Change in peak flow • Change in A.C.T. scores. • Increased knowledge • better controlled asthma	• Increased knowledge • self-efficacy • enhanced communication of clinicians with patients	• improved treatment adherence • increased knowledge • Improved self-efficacy	• Shifting intentions • Characters and situations believable • Usability positively rated

Author(s)	K. Huss, M. Winkelstein, J. Nanda, P. Luers Naumann, E.D. Sloand, R.W. Huss	C. N. Mhurchu, R. Maddison, Y. Jiang, A. Jull, H. Prapavessis, A. Rodgers	L.H. Epstein, M D. Beecher, J.L. Graf, J.N. Roemmich	D.E.R. Warburton, S.S.D. Bredin, L.T.L. Horita, D.Zbogar, J.M. Scott, B.T.A. Esch, and R.E. Rhodes
Reference	Computer game for inner-city children does not improve asthma outcomes (United States, 2003)	Couch potatoes to jumping beans: A pilot study of the effect of active video games on physical activity in children year and location (New Zealand, 2006)	Choice of interactive dance and bicycle in overweight and nonoverweight youth (America, 2007)	"The health benefits of interactive video game exercise (Canada, 2007)
Title	Wee Willie Wheezie	Eye toy physical activity games	Dance Dance revolution	Gamebike
Genre	role playing/ action adventure	Exergame	Exergame	exergame
Type of game	Behavior change game	Physical game	Physical change game	Physical change game
Theory	Precede-proceed model	Unknown	Unknown	Unknown
Change methods	Feedback, modeling	Action by doing	Action by doing	Action by doing
Game elements	Unclear	Unclear	Exercise (physical) and interactivity	Exercise
Target behavior	preventing asthma symptoms	Physical activity	Increase physical activity	Physical activity
Target group	Children (7-12 years)	Children (10-14 years)	Children	Males (22-28)
Game intervention	Educational	Physical activity	Physical activity	Physical activity
Study design	2-armed RCT pre-/ post-test	Randomized intervention study	Two-group design	Randomized controlled trial
Data gathering methods	Demographic, data allergic asthma questionnaire. pediatric asthma quality of life questionnaire (PAQOL). an asthma knowledge test air control questionnaire, spiromettry	Accelerometer, physical activity questionnaire for children	7-point likert scale quesionnaire	Ellectronically brakedergometer
Sample size	148	20	35	14
measures	Asthma symptoms	Physical activity	Preference	Aerobic power
Intervention	The intervention group reviewed 20 min. the games *the magic school busexplores the human body* and 20 min. the game Wee Willie Wheezie. The control group only played the magic schoolbus for 20 min.	supply of an active video game upgrade package consisting of an EyeToy® camera, EyeToy® active games, and dance mat, or control (no intervention). Participants and their parents or guardians were instructed to substitute usual non active video game play with active video games (EyeToy® and dance mat). The control group received an active game upgrade package upon completion of the study.	Each child participated in two different conditions. The dance game and the bicycle game. Within these conditions each child participated in three choice conditions. In each comparison of one of the alternatives was playing the dance game with the game controller or the bicycle game with the game controller.	The intervention group exercised on a Gamebike. Recommended was moderate density, but participants were free to choose otherwise. Participants could choose between a variety of games provided with the gamebike. Control group exercised with traditional fitness bike.
Time of exposure	12 weeks	12 weeks	60 minutes	6 weeks
Primary outcome	Behavior change	Physical activty	Behavior change and motivations	Health related outcomes and attendence
Fun experience	Unclear	Not reported	Interactiivity	Not reported

| Results | • No differences between groups were found. | • Physical activity higher in intervention group
• No significant differences in time spent in moderate and vigorous physical activity between groups
• Boys more active than girls
• Intervention group spent less total time in playing games | • Significant difference in liking of the dance activities.
• No significant differences in liking for any of the bicycle conditions.
• Nonoverweight children showed an increase in activity, whereas overweight children did not increase their activity across alternatives | • Increased VO2 max
• Greater reduction in resting systolic blood pressure
• Greater attendance
• |

Author(s)	L. Graves, G. Stratton, N. D. Ridgers, N. T. Cable	L.E.F. Graves, N.D. Ridgers, G. Stratton	*L.LANNINGHAM-FOSTER, R. C. FOSTER, S. K. MCCRADY, T.B. JENSEN, N. MITRE, AND J. A. LEVINE,*
Reference	Energy expenditure in adolescents playing new generation computer games (United Kingdom, 2007)	The contribution of upper limb and total body movement to adolescents' energy expenditure whilst playing Nintendo Wii (Liverpool, 2008)	*Activity-Promoting Video Games and Increased Energy Expenditure (America, 2009)*
Title	Wii Sports (tennis, bowling and boxing)	Wii Sports (tennis, bowling and boxing)	Wii Sports (boxing)
Genre	Exergames	Exergames	Exergames
Type of game	Sports	Sports	Sports
Theory	Unknown	Unknown	Unknown
Change methods	Action by doing	Action by doing	Action by doing
Game elements	Not reported	Not reported	Not reported
Target behavior	Physical activity	Physical activity	Physical activity
Target group	Children (age 13-15 years)	Adolescents (11-17 years)	Children and adults
Game intervention	Physical activity	Physical activity	Physical activity
Study design	Cross sectional comparison	Randomized experimental trial	Single group study
Data gathering methods	IDEEA System	Archiheart, Actigrapf accelerometer, Metamax 3B	PAMS (activity measurement system), inclinometers, triaxial accelerometers and data loggers to continuously
Sample size	11	13	42
Measures	Energy expenditure	Energy expenditure	Energy expenditure
Intervention	Participants were fitted with a monitoring device validated to predict expenditure. The played four games each 15 min. one of the games was sedentary.	Participants were fitted with an Actiheart, four ActiGraphs and the MetaMax 3B system. Resting EE (REE) and resting heart rate (RHR) were measured for 6 min by the MetaMax and Actiheart HR sensor, respectively, following at least 2 h fasting and 5 min of supine rest. In a randomised order participants played for 15 min on each video game (PGR3, Wii Sports boxing, bowling, tennis) with 5 min of seated rest between each.	The participant rested in a dimly lit room for 30 minutes. Resting energy expenditure (REE) was then measured for 20 minutes with indirect calorimetry as aforementioned. -Participants watched an age-appropriate video while sitting and standing. -Energy expenditure was measured for 10 minutes each while sitting and then standing. The participant was allowed to play the sedentary video game (Disney's Extreme Skate Adventure) for approximately 3 minutes to familiarize himself or herself with the game. Energy expenditure was then measured for 10 minutes while playing the traditional video game while seated. Participants were allowed to rest for 5 minutes between video game systems. The participant was then allowed to play the activity promoting video game (Wii Sports Boxing) for 3 minutes for familiarization. Energy expenditure was then measured for 10 minutes while playing the activity-promoting video game while standing.
Time of exposure	60 minutes	60 minutes	unclear
Primary outcome	Energy expenditure	Upper limb and body activity	Energy expenditure
Fun experience	Not reported	Not reported	Not reported
Results	More energy is used playing active games	• Energy expenditure greater in treatment group • Upper limb and total body activity greater in treatment group	• For children, there were significant increases in energy expenditure over REE for all activities • Energy expenditure increased significantly greater than all other activities when children played Nintendo Wii

98

		99	• For adults, there were significant increases in energy expenditure greater than REE for standing (playing the traditional video game, and playing Nintendo Wii • Energy expenditure increased significantly greater than all other activities when adults played Nintendo Wii. • There were no significant differences in energy expenditure by sex for children or adults.

Author(s)	Debbe Thompson, Tom Baranowski, Richard Buday, Janice Baranowski, Melissa Juliano, McKee Frazior, Jon Wilsdon, and Russell Jago	W. Peng	M.C. Munguba, M.T.M. Valdés, C.A.B. Da Silva	T. Baranowski, J. Baranowski, K.W. Cullen, T. Marsh, N. Islam, I. Zakeri, L. Honess-Morreale, C. deMoor.
Reference	In Pursuit of change : Youth Response to Intensive Goal Setting Embedded in a Serious Video Game (America, 2007)	Design and Evaluation of a Computer Game to Promote a Healthy Diet for Young Adults (America, 2009)	The application of an occupational therapy nutrition education programme for children who are obese	Dietary Outcome Evaluation of a Multimedia Game (United states, 2007)
Title game	Escape from Diab (Diab) and Nanoswarm: Attack from Inner Space (N)	RightWay Café	Unknown	Squire's Quest!
Genre	Action-adventure/role playing game	simulation	Unknown	Action-adventure
Type of game	Diet and physical change game	Diet and physical change	Diet change	Diet change game
Theory	Social Cognitive Theory (SCT), Elaboration Likelihood Model (ELM), Behavioral Inoculation Model (BIT), Self Determination Theory (SDT	Theory of reasoned action, health belief model, social cognitive theory	Metacognition, intrinsic motivation, learning strategies	Social Cognitive Theory
Change methods	Goal setting, goals review, problem solving, decision making, implement intentions, tailoring, modeling	Interactive tailoring, modeling, intrinsic motivation, feedback, review content, rewarding points, goal setting	Decision making	Tailoring goals, decision making, goal setting and problem solving
Game elements	Interactivity, story/fantasy, decision-making, asking and negotiation (interactivity)	Competition, challenge, story, experimentation, humor, interaction with virtual coach	Interaction with the system (computer game). Interaction with other players and competition (board game)	Interactivity, story/fantasy, challenging goals Decision making, rewards
Target behavior	Increase fruit, vegetable, water intake and increase physical activity	Diet change and physical activity	Changing eating habits	Increase fruit and vegetable intake among healthy children
Target group	Preadolescents (9-11 years)	Adolescents (age 20)	Children (8-10 years)	Children
Game intervention	Behavior change	educational	Educational	Educational
Study design	Alpha testing	Randomized controlled evaluation	Quasi-experimental study	Two-group design with pre- and post-assessment
Data gathering methods	Observations, interviews,	Questionnaire, 14-item self-efficacy of healthy eating scale, perceived benefits were measured by using 5-item scale, perceived barriers by 4-item scale.	Semi-structured interviews Structured observations Focusgroup	Food Intake Recording Software System (FIRSSt). FIRSSt is an interactive, multimedia dietary assessment program that simulates a multiple-pass, 24-hour dietary recall
Sample size	Unclear	32	200	1479
Measures	Usability, goal review, goal setting	Knowledge, self-efficacy, perceived health benefits, perceived barriers	Preference, experience and attitudes. Attitudes with respect to (1) the possibility of learning while playing; (2) fantasy during the learning process; (3) learning the concepts of nutritional education; and (4) the need for help in learning.	Four days of dietary intake were assessed before and after the intervention
Intervention	youth alpha tested early versions of two episodes of each video game.	Watching powerpoint tutorial about the game. Then playing the game.	comparing two interactive games based on the food pyramid (video game and board game) used individually and then combined.	Playing Squire's Quest! Two times a week at elementary school
Time of exposure	Nine session of one hour	About 42 minutes	Once a week for 4 months	10 sessions of 25min., twice a week for 5 weeks

Primary outcome	Usability	Behavior outcomes	Behavior outcomes	Behavior related to fruit and vegetable intake
Fun experience	• Goal setting (but too easy) • Alpha testers engaged during goal review • They paid attention to problem solving and answering problem-solving questions related to goals they were planning to retry. • Alpha testers thought goal review was a little easy and a little fun.	Players enjoyed playing the game	• Unclear	Not reported
Results	See fun experience	• Increased knowledge after intervention, not at follow-up • Increased self-efficacy, also at follow-up • Increased perceived benefits, not with other data • Increased perceived barriers after intervention, decreased at follow-up • Increased intention to follow healthy diet .	• More experience with video games • The children's attitudes, differed significantly between the two games.	More fruit and vegetable intake

Appendix H: Storylines

These storylines are deducted from the articles.

Packy & Marlon
Players help their character gather up food and diabetes supplies, which marauding rats and mice have scattered throughout the camp. Players must also help their character monitor blood glucose, take appropriate amounts of insulin, review a diabetes logbook, and eat foods containing a good balance of food exchanges (bread, fruit, meat, milk, vegetables, and fat) for three meals and three snacks a day, during four simulated days.

Bronkie the Bronchosaurus
The game is set on the prehistoric planet of San Saurian. Years ago meteors struck, filling the air with clouds of dust. The inhabitants of San Saurian developed a wind machine to clear the dust from the air, but an evil Tyrannosaurus Rex stole the machine and scattered pieces of it all over San Saurian's cities, lakes, jungles, skies, canyons, and caves. Dust clouds are returning, and Bronkie and Trakie must find and assemble pieces of the wind machine before it's too late. While searching, they must manage their asthma and fend off evil dinosaur thugs who are guarding the machine pieces. Proper asthma management earns points and is essential for a player to win the game.To manage their character's asthma, players must make sure the character takes daily medication; uses an inhaler and spacer correctly; avoids asthma triggers such as dust, smoke, pollen, furry animals, and cold viruses; monitors peak flow (breath strength) with a peak flow meter; responds to changes in peak flow; uses a sick day plan appropriately; reviews an asthma logbook that has the character's cumulative record of medications taken and highest and lowest peak flow levels each day; and learns about asthma management. Multiple-choice questions cover topics including the respiratory system; basic asthma self-management; identifying and avoiding triggers; recognizing and responding to early warning signs; what to do in asthma emergencies; the purpose of asthma medications; the importance of following a sick day plan; asthma and strenuous exercise; and how to handle common social situations.

Re-mission
Re-Mission47 (www.re-mission.net) is a PC game in which players control a nanobot, "Roxxi," in 3-dimensional environments within the bodies of young patients with cancers that commonly are diagnosed in AYA. Game content was engineered to address behavioral issues that were identified in literature reviews and preproduction targeting studies48–54 as critical for optimal AYA patient participation in cancer treatment. Video-game play includes destroying cancer cells and managing common treatment-related adverse effects such as bacterial infections, nausea, and constipation by using chemotherapy, antibiotics, antiemetics, and a stool softener as ammunition. To win, players control the nanobot, Roxxi, to ensure strategically that virtual patients engage in positive self-care behaviors, such as taking oral chemotherapy to fight cancer cells, taking antibiotics to fight infection, taking stool softeners to prevent bowel perforations, practicing good mouth care to combat mucositis, using relaxation techniques to reduce stress, and eating food to gain energy.

Heart sense
Heart Sense provides a game-based representation of the decisions made by virtual personas suffering from a potential myocardial infarction. The user seeks to convince these personas to overcome their delay issues, and by that, learns to deal with their own such issues. Placing the message ("rapid identification of cardiac scenarios and appropriate responses") in the context of an entertaining game puts the game within the intellectual reach of a majority of the public, including older children, who may be the only bystander at a heart attack event.

Escape from Diab and Nanoswarm
Diab, told from the third-person perspective, uses three-dimensional sets and animated characters to tell the story of DeeJay, an athletic and healthy modern-day youth who falls through the floor of an abandoned building. He awakens to find himself in the dark and dreary land of Diab, where fruit, vegetables, and physical activity are forbidden by the evil King Etes. Upon his arrival, DeeJay is befriended by a group of Diab youth. Together, they develop a plot to escape. To develop the mental acuity and physical strength needed to outwit King Etes and his guards, DeeJay mentors his new friends in healthy eating and physical activity behaviors. The player engages in behavior change activities as part of game play. The ending the player receives (i.e., whether or not the characters have the option to escape) is dependent on his/her personal performance in the behavior change components of the game.

Nanoswarm, told from the first-person perspective, uses live actors and blue screen technology. In a futuristic laboratory, teenage scientists attempt to help Dr. Gunderson (the lead scientist who is an adult) control renegade nanobots, small machines originally designed to keep the environment free of garbage and pollutants that now appear to be attacking people. Dr. Gunderson created the nanobots, and his laboratory is charged with getting them under control. During the crisis, Fred, one of the teenage scientists with poor eating and physical activity habits, falls ill and is near death. To keep Fred alive until the source of his illness can be discovered, the characters (including the player) have to keep Fred's energy meters balanced by eating healthy and being physically active. As in Diab, the player participates in behavior change components embedded in game play.

RightWay Café
RigthWay Café simulates a 3-week period in a similar fashion as the popular game, The SIMS. The background story of the game is set in a hypothetical reality TV show called "Star of Healthy Lifestyle" on campus and the game player is a competitor in this show. The person who can best manage his or her daily diet in a healthy way will win. At the beginning of the game, the player will create his or her avatar by entering personal information, such as name, weight, height, age, gender, physical activity, and body frame. Even though the player can create any profile desired, the participants of this study used their own personal information to create their avatars. Based on the specific physical attributes of the avatar, the game provides tailored healthy eating information: (a) optimal weight for this particular avatar, (b) suggested daily calorie consumption for this avatar, and (c) personal food pyramid for this avatar. The goal of the player is to manage daily calorie consumption and physical activity to enable the avatar to reach optimal weight. The player's food choices also need to match up with the avatar's personal food pyramid. For instance, the player creates a female avatar who is 20 years old, 5 ft 6 in., 160 lb, with medium body frame, and 30 min a day exercise on most days. Based on this profile, the game provides the player with tailored information that (a) the optimal weight for a 20-year-old, 5 ft 6 in. tall female is 145 lb, (b) the suggested daily calories are 2,200, and (c) these 2,200 calories should be contributed by 7 oz of grains, 3 cups of vegetables, 2 cups of fruits, 6 teaspoons of oils, 3 cups of milk products, and 6 oz of meat so as to match the suggested personal food pyramid. As this avatar is a bit heavier than the optimal weight, the player needs to either consume about 95% of the required calories (2,100 calories) or engage in more than 30 min a day of physical activity to reach optimal weight. While role-playing in the game, the player rehearses diet and weight management skills by choosing breakfast, lunch, dinner, and snacks for his or her avatar/character in the game. There are eight categories: entrée, side, salad, dressing, fruits, drinks, dessert, and snacks. Figure 2 is a screen shot of the food selection interface. Before deciding what kind of food to "eat," the player can check the nutrition information by clicking the picture of each food item, For each item, the following nutrition information will be provided: total calories, serving size, equivalent servings for the six food pyramid categories (grains, vegetables, fruits, oils, milk, and meat & beans), and the potential benefit or harm of consuming this food item. If the player decides to choose an item, he or she can click "ADD" to put the item into the plate and the meters on the bottom left corner will dynamically update to indicate the nutrient consequence of consuming this particular food item. At the end of each week the game will simulate the weight change based on the foods the player chooses. Constructive feedback and reviewers will also be provided to the player. Through trial and error, players observe the consequence of their food choices on weight change in the virtual environment. The game simulation provides a virtual environment in which people can experiment with food selections and exercise control so as to increase their self-efficacy of healthy eating. The competition and challenge of the game, the reality TV show background story, and experimentation with food in the virtual game

environment are all intended to make the game fun. In addition, the script of the conversation includes humor to add another element of fun to the game.

Squire's Quest!
The story line for the game was as follows: the kingdom of 5A Lot was being invaded by the Slimes (snakes) and the Mogs (moles), who were attempting to destroy the
kingdom by destroying the fruit and vegetable crops. King Cornwell and Queen Nutritia were leading their knights (e.g., Sir Sarah See-a-Solution and Sir Alex Try-to-be-Right) to defeat the invaders. In the first session, the fourth-grade child committed to becoming a squire in the pursuit of becoming a knight to help the king and queen. The squire had to face challenges in his/her quest. The challenges involved skills and goals related to eating more fruit, 100% fruit juice, and vegetables. The squire prepared FJV recipes (in a virtual kitchen) to provide energy for the king and court to fight the invaders. A wizard mentored the child through the challenges, and the castle robot (Mad Maxie) facilitated many of the educational sessions. The invaders kidnapped the good chef (Chef Karat) and replaced him with Chef Mog, a bumbling fool, who always usurped the squire's accomplishments to make himself look good to the king.
Before the end of each session, the child set goals to make the recipe (prepared in the virtual kitchen) during that session, eat another FJV serving at a meal or as a snack, or to ask for his/her favorite FJV to be more available at home. The children participated in a decision-making activity between their favorite fruit, juice, or vegetable and a more common snack. The FJV was selected based on the child's food preferences reported at baseline. The decision criteria were the three most important outcome expectancies reported by the child at baseline. Sessions 2 to 10 began with an assessment of whether the goal from the previous session was completed, for which dragon-scale points were assigned. A problem-solving routine was employed to help the child assess how he/she might change practices to increase the likelihood of goal attainment. Table 2 presents a list of session activities, in rough order of sequence within a session. All children attained knighthood (ten possible levels) at the end of the ten sessions, with the level determined by the number of dragon-scale points earned. Points were earned primarily by attainment of goals, with smaller amounts of points earned from the educational games. Examples of these games included identifying what counted as fruit, what counted as vegetables, and whether a demonstration of asking would likely result in making FJV more available.

Appendix I: Priority lists

Game elements			
	High priority	**Moderate priority**	**Low priority**
Functionality			
Performing exercises together		x	
Playing the game alone			x
Possibility to play with a group, because of short duration of the game		x	
Two player option in real life		x	
Two player option		x	
Exchange recipes with others		x	
Choosing between different options			x
Giving compliments		x	
Speedbonus		x	
Upgrading difficulty level		x	
Building up reaction time	x		
Preparing recipes in real life, with guidance of virtual cook		x	
Preparing recipes in virtual kitchen		x	
By using balance board		x	
By using Gamebike whereby you decide the speed of the game		x	
Keep up high scores		x	
Challenging others			x

Behavior change methods			
	High priority	**Mediocre priority**	**Low priority**
Functionality			
A coach (real person) gives directions via a mp3-player	x		
A virtual coach gives directions		x	
Choosing own work-out scheme		x	
Register data about weight, height and other health related data in order to formulate personal goals	x		
Choosing recipes based on difficulty, amount of calories, cooking methods and preparing time	x		
Choosing music during work-out		x	
During training feedback on performance	x		
After training information about performance on a website	x		
Exchange information via website			x
Rehearsal skills			x
Intense physical activity	x		
Moderate physical activity		x	
Being visible in the game (via camera)	x		
Making your own character	x		
Based on personal data		x	
Asking for instruction films for more information			x
Getting advice during work-out about sport outfits, sport shoes, nutrition, preventing injuries			x
Information about food labels			x

Appendix J: Events visited

Workshop XNA
The workshop was organized by the student union Inter-Acitve and Microsoft. During the workshop the participants learned how they could develop a videogame with the software package XNA.

Symposium 'Games en Gezondheid: Beter Worden met Games'
The symposium was organized by Taskforce Innovatie Regio Utrecht - Expertise Centrum Games en Game Design. Interesting speakers and topics during this symposium were:
- Prof. Dr. Geert Blijham, President of the board of the Medical Academic Centre. He emphasized the importance of health and innovation.
- Jeroen van Mastrigt, teacher at the Hogeschool voor de Kunsten Utrecht. He discussed the application of games in health care from the perspective of a game designer.
- Michaël Bas (Ranj Serious Games) and Fred Balvert (Erasmus Medical Centre) focused on the link between game development, the game industry and health. The games The Great Flu and GRIP were discussed as examples.
- Joris Wiersinga developer of Silverfit. He explained the development of Silverfit.
- Bas van Haren employee at MAD Multimedia, told about the application of "Gaming in de Zorg", a cooperation between Academic Medical Center Groningen, homecare Groningen, and Lentis. This presentation showed the importance of a proper link between design and practice.
- Paul van Garderen en Stefan Tijsen (Sensamove) showed how their game, Sensamove, worked.
- Aileen The (Games4Health) stressed the necessity of a platform for the development and knowledge distribution of serious games in health care.

The most important outcome of this symposium was that there are a lot of possibilities for games in health care, but that it more knowledge is needed and that it is necessary that the different disciplines involved need to work together.

Appendix K: Sources game fragments

The great flu	http:// www.thegreatflu.com
Quest for the Code	http://asthma.starlightprograms.org/
Nutrition Decision	http://www.nutritiondecision.net/
Re-mission	http://www.re-mission.net/
Innov8	http://www-01.ibm.com/software/solutions/soa/innov8/index.html
Wii Fit Trailer	http://www.youtube.com/watch?v=j2XYRd28TOM
Silverfit	http://www.youtube.com/watch?v=3-yr5NICB7M
Gamebike	http://www.youtube.com/watch?v=16jMoQdy6YY