Making Computer Games that Can Teach Children with Type 1 Diabetes in Rural Areas How to Manage Their Condition

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Abstract

Computer games can teach children a number of skills. But in order to cultivate enough engagement so that players will want to learn, the games must be sufficiently entertaining. Making good computer games is not trivial, and also not something strictly sticking to a method or script can accomplish. In the CADMOS project, we have tried to tap into kids' general interest and fascination with computer games, to teach children aged 8-12 with Type 1 diabetes how to deal with their condition in an optimal way. This will be achieved by the use of serious games that are easy to understand, yet fun to play, where they can experiment with variable treatments of their own illness in a safe space on virtual avatars instead of themselves. We also want to achieve synergistic integration with other diabetes-related treatment and self-management tools, which are already being used by children in the target group. Furthermore, it is a goal that the children's friends and family members should also be able to participate in the game and thereby gain a better understanding of what it means to live with diabetes. In this paper we show how we can get closer to this goal by designing the game iteratively together with members of our user group.

Keywords:

Video games, Diabetes Mellitus, Self-Management.

Introduction

Computer games can - as long as they are fun to play - be a valuable tool to teach children any number of skills. After all, it is easier to learn something when you enjoy doing it, and games can be a valuable source of inspiration if you live in a rural area where access to other people is limited.

The problem is that in order to get enough engagement so that players will stick with a game, just taking the game and wrapping it around some learning material is not enough. While there is little doubt that children learn from games, there are very few games that are able to specifically teach a particular skill. In order to accomplish this, the game should first and foremost be something that the intended user would want to spend time with. Creating something that qualifies in this regard is however more of an art form than an exact science. Even in commercial game development, where you only need to create something fun and not worry about teaching, the ratio of what becomes successful is very low. But it is easier to get there by involving the intended users in the design.

The core part of the CADMOS project is the development of a serious computer game for connecting children and adolescents with T1DM (Type 1 diabetes) in rural areas. Our hypothesis is: By combining mobile phones, medical sensors, social media and serious video games, a motivational and useful educational tool can be constructed, improving the self-management skills of young T1DM patients considerably.

The project has an experimental, user-oriented approach, and includes an in-depth analysis of the problem area, including social video game design for children and adolescents. Our prototype game is based upon development experience and published research on game development and social media. The project has involved children and adolescents with T1DM and their parents [1], but also researchers and developers of diabetes technology and self-management systems.

The CADMOS project is part of on-going research in Tromsø, Norway, on serious games for children and adolescents with T1DM, and includes several computer games [2-6].

Only a few existing games for children with T1DM have been made, and even fewer are generally available. [7] Two of the most interesting are "Diabetic Dog" [8] and "Carb Counting with Lenny" [9].

The Diabetic Dog Game is a serious game from Sweden (Nobelpriskampen 2009; Nobel Web AB, 2010) [10], where the users must take care of a dog with T1DM. Blood sugar levels, insulin levels, and other parameters such as mood affect the dog, and the player must make decisions and actions accordingly. The main goal of the game is to take care of the dog and make sure it is happy and healthy by giving love and affection, arranging walks, providing food, and supplying insulin.

In 2011, Medtronic released the game "Carb Counting with Lenny" (Medtronic, 2011). The game contains four mini-

games. The goal for all four games is the same – to increase knowledge about carbohydrate content in different food groups. In this way, the children can learn to manage their own food intake. It consists of two major parts:

1. Lenny's Food Guide helps kids learn carb values for many food items across the basic food groups.

2. In Lenny's Carb Games, children can test their knowledge with four interactive games: Carb or No Carb, Compare the Carbs, Guess the Carbs, and Build a Meal.

In this paper we describe the iterative design approach used in the CADMOS project, and how we have been able to engage our user group by making them part of the process.

Materials and Methods

The development project has been through two iterations:

1. Initial development work on game mechanics suited for teaching, and getting feedback on design from fellow computer game designers.

2. Presenting the game to kids in the target age group, and receiving feedback and suggestions on how the game can be improved.

We have used an ethnographic approach to gather information on how the users experience our game. We observe them whilst they play, paying particular attention to non-verbal cues as well as what they are saying, in order to determine whether they are enjoying the experience or not. We also make notes of what parts are working as intended and what parts need more work.

Stage 1: Developing the initial prototype

The initial development started as part of "Tromsø Gamelab", a one-off experiment at UIT – The Arctic University of Norway. This collaboration between academia and local game developers was aimed at creating a curriculum combining computer science with commercial and practical aspects of designing, developing and releasing a video game.

We decided to create a battle-arena game, where you pit a team of characters against an opposing team to see who wins. The plan was to create a simple but functional game mechanic, to use as a starting point for further development into something that could teach diabetes management to children and adolescents.

In order to justify putting the diabetes related parts into the game at a later stage, we created a backstory that would facilitate this. The game is set in a distant future, where humanity is genetically and mechanically enhanced in ways that practically gives them superpowers. The downside to this enhancement is that it also gives them the functional equivalent of diabetes, and thus everyone is heavily reliant on injecting insulin.

Stage 2: Getting feedback and improving the design

The next step was to test whether we were on the right track by presenting our game to children in the appropriate age group. This was done as part of a workshop organized by members of our local diabetes community. Our audience was 11 kids aged 12-17 and their parents.

This event gave us a chance to demonstrate and talk about our project to both the children and their parents. As part of the workshop, we also invited the kids to participate in the development process by designing new characters, giving feedback on what was already implemented and coming up with ideas for how to make the game even better.

Figure 1- Participants of the game design workshop

In order to get somewhere concrete during our session, we settled on one idea to focus on: *How to visualize the balance between fullness level (with regards to food) together with blood glucose level?* Preferably in a manner that would be easy to read and understand. We then workshopped a possible implementation together with the kids, using paper and whiteboard.

Results

The initial game design went through a number of visual styles before we settled on something that appealed to the other developers. This was the design we presented to the kids:

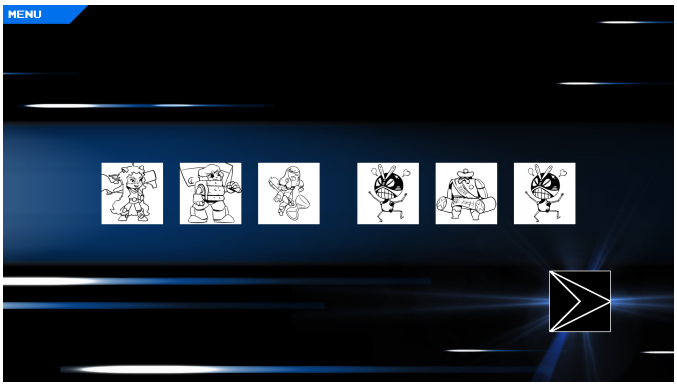

Figure 2- Screenshot from the game.

Upon doing so, we learned that the current state of our game appeals more to boys than to girls. According to one of the participants it also appeals even more to those who like science fiction in particular.

About a third of the kids really liked being involved in the design process. Another third was somewhat passive, and the last third was actively disinterested. Practically all those that liked being part of the process volunteered to continue working with the game as testers after the end of the workshop.

The workshop resulted in a prototype designs for important user interface elements that can be used in the game. Since the intended users of the product helped design it they should also be able to more easily make use of it.

Discussion

Part of the reason we chose to make the characters into cyborgs with diabetes is that an earlier workshop with the children from when they were younger, indicated that humanoid characters were usually envisioned when they were asked do draw up suggestions for games, and thus the most likely avatar type to elicit engagement [11].

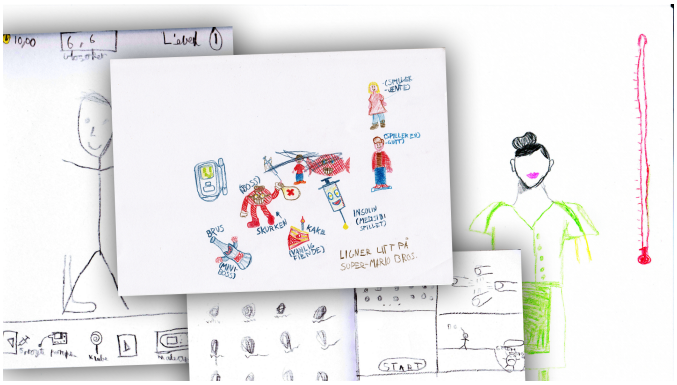

Figure 3- Sample drawings from a similar workshop in 2013

But the cyborg characters also make it easier for us to handle things like death and injuries in game. We wanted the option to bring back to life characters that were seriously injured or killed, and the robotic aspect makes it plausible that characters can be "repaired".

The main reason for this buffer against fatal consequences is that we want to encourage experimentation, as that is one of the best ways to learn. In real life however, people with T1DM who are dependent on manual insulin injections can potentially die from complications associated with incorrect dosages. Badly managed insulin and blood glucose levels over time can also lead to disabilities like blindness and kidney failure. It is therefore not advisable to do experimentation with one's own body, but a computer game provides an arena that allows it to be done on avatars in a safe space.

By allowing the characters in the game to be repaired should anything go wrong we could also keep any emotional bonds the players have developed to them intact.

As the primary purpose of the work so far is putting together a game that children like playing, it is currently difficult to determine whether they are actually learning anything from it. This will eventually be something we have to test by comparing children with T1DM who play the game, with a control group of children with the same illness, but no access to the game. If we find that blood glucose levels are closer to the ideal in the first group after an appropriate amount of exposure to the game than in the second, we can conclude that it is likely working as intended.

The next phase of the project will be to import health data from on- and off-body monitoring equipment into the game. The idea is that data from sensor equipment such as step counters, glucose meters, digital body thermometers, etc., can be integrated as part of the experience.

We plan on several extensions. One idea is to let the player take the role of a diabetes adviser, who assists patients with their day-to-day activities. Each patient will present a different situation/problem that they need help with. The player will be able to see recent blood glucose measurements, dietary information, physical activity, and to ask the patient questions, and based on this, give advice. Based on the actions performed, the player will be rewarded points and achievements and the virtual patient will be either happy or unsatisfied with the help they received. The points and achievements received can be posted to an online leader board, and to the players social media profile, thus making it sharable with other people also playing.

We also want to experiment with a mixture of avatars with T1DM and real users/players, in which the players can compete with each other as well as the avatars, about being better regulated. This requires that the metabolism models and other physical models on which the avatars are based on should be as realistic as possible.

Conclusion

The results received along with the feedback from the user group indicate that the game has potential to be a useful tool for children and adolescents to learn about diabetes. We believe that this will be important to improve self-management

for children and adolescents with T1DM who live quite far from each other. Especially for adolescents, T1DM can be stigmatising. If their friends don't understand why they have to measure blood glucose level and inject insulin, it is sometimes socially difficult to do so. But a shared game experience may make it easier.

Further implementation and testing is of course needed to assure that the learning goals can be met, and that is also how we plan to continue going forward, until both we and our user base is sufficiently satisfied with the game as a tool for learning to manage diabetes.

Acknowledgments

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