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Edutainment Tools for Initial Education of Type-1 Diabetes Mellitus: Initial Diabetes Education with Fun

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Abstract

Purpose: Appropriate initial education for type-1 diabetes mellitus patients is important to prevent late complications. However, type-1 diabetic children have not appreciated tra- ditional learning methods since they rarely contain the ele-ments of fun and interactivity. In this study, we developed, implemented and evaluated a preliminary version of edutainment tools for initial education for type-1 diabetic children.
Methods: Three games running on either personal computer(PC) and GameBoy Advance™ were developed. All games were designed to educate patients about relationships among food (carbohydrate), plasma glucose level, exercise, and insulin dose. A total of 58 testers evaluated degree of entertainment, usability and clinical usefulness of the games.
Results: Generally, testers felt all games were intuitive and tes education which they find boring and lacking in intera ction. fun and the usability of games was highly scored. More than 90% of testers showed an interest in the edutainment approach, and approximately 60% agreed that these games could provide attractive educational environment compared to traditional education, especially for children. between users and edutainment systems have been recognized
Conclusions: Our edutainment systems were accepted as attractive learning tools for type-1 diabetic children who need initial education.

Keywords:

Edutainment, Type-1 diabetes, Game, Learning tool

Introduction

An appropriate initial education and continuous care delivery by pediatric diabetes specialists is quite important in the prevention of late complications following type-1 diabetes mellitus. However, such specialists are not always available.

Previously, we performed an evaluation of patients' needs, current situation and environment for initial and continuous care for type-1 diabetes patients in order to identify an optimal tool for initial education and continuous care [1] . We found that patients did not think that they had acquired sufficient basic knowledge of diabetes mellitus. In addition, patients lacked an appreciation of traditional educational lectures. Even multimedia learning tools , such as videos, did not appeal to them. Some patients revealed that they are bored with current diabetes education which they find boring and lacking in interaction.

On the other hand, "edutainment", which engages entertaining, and media-based materials to promote learning, has been recognized as an attractive approach to improve educational outcomes. Games which could provide dynamic interaction between users and edutainment systems have been recognized as one of the favorable ways to provide hands-on and individualized learning programs [2,3].

In this study, we have developed an edutainment tool for initial education of type-1 diabetes patients, which utilizes video game in education delivery. In addition, we evaluated the education tools in terms of usefulness of the game for initial diabetes education.

Materials and Methods

Development

Three development teams were formed at the HAL College of Computer Technology for this project. Diabetes specialists and nurses participated in the development process to provide basic information of type-1 diabetes mellitus and diabetic care for children. Game development was created using the following process.

1) Plan the game

Each development team was consulted when deciding the general idea of the game, such as rules, conditions to complete, and characters of the game.

2) Determine specifications for the game

The next process is variables determination and algorithms development. For examp le, the formula to simulate plasma glucose level, factors influencing on the plasma glucose level, action speed of each character, and timing of screen movement were established during this step. All variables, formula, and algorithms were summarized for each person in charge of different part of game development in the following step.

3) Create the game

Graphics, music and program were generated based on the specifications decided in the above process. Each development team involved 1-2 people in charge of graphic design, music composition and programming.

4) Adjust details of the game

Finally, all games were tested and details were adjusted accordingly.

Evaluation

A total of 58 type-1 diabetic patients and healthcare professionals who attended a summer camp in Kochi prefecture, Japan, evaluated the games. All testers were asked to fill out the questionnaire in order to assess the usefulness of the developed edutainment system.

Table 1: Questions in the Questionnaire

No	Questions
Degree of entertainment	
1	Did you have a fun with the game?
2	Do you want to play the game again?
3	Is the game too long?
4	Do you recommend the game to diabetes friends?
5	Do you recommend the game to non-diabetes friends?
Usability	
6	Are characters readable?
7	Are images easy to recognize?
8	Do you have any trouble to play the game?
9	Are your eyes tired after the game?
10	Are your arms tired after the game?
Clinical usefulness	
11	Are you interested in edutainment approach for healthcare education?
12	Do you think it is useful for initial education for type-1 diabetes?
13	Do you think the game reflect "real" diabetes situation?

The questionnaire includes 14 questions corresponding following three assessment categories.

- Entertainment
- Usability
- Clinical usefulness

Table 1 shows all questions in the questionnaires. All questions are asked with scaling 1 to 5 (1= strongly dis agree, 2= dis agree, 3= somewhat, 4= agree, 5= strongly agree).

Furthermore, we interviewed all participants to ask for additional detail comments regarding the general idea of the edutainment for type-1 diabetes education.

Results

We have developed one PC game and two games for GameBoy Advance ™ (Nintendo, Inc.). The tile of PC game is "Tamagoya" which means an "egg breeder". The titles of GameBoy Advance ™ games are "Tantei", which means "detective" and "Magic Toom", which means "buildup blocks".

Following are the description of each video game.

Description of Each Game

1) Tamagoya (Egg Breeder)

The Egg Breeder is designed for patients who have been just diagnosed as type-1 diabetes to understand general idea regarding relationship among plasma glucose, insulin prescription, food taking and exercise.

In the game, a player will be asked to breed a diabetic egg with providing appropriate foods, exercises and insulin to breed the egg in healthy conditions.

Figure 1 shows one of the introduction screens of the Egg Breeder. A player will learn how to play the game during the introduction.

Figure 1 - Introduction of the "Egg Breeder"

Once the main game is started, a player needs to choose one of the following actions: providing food, insulin, and exercise to the egg, based on information of plasma glucose level in quantitative (i.e. very high, high, normal, low and very low) on left upper side of the screen (Figure 2).

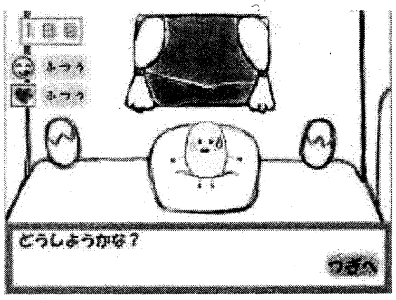

Figure 2 - Main screen of "Egg Breeder"

If a player selects "exercise", an egg starts to play with her/his friends (Figure 3).

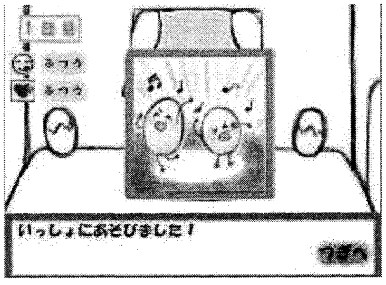

Figure 3 - Screen during exercising with eggs"

One week after a player has bred the egg, the egg hatches (Figure 4)

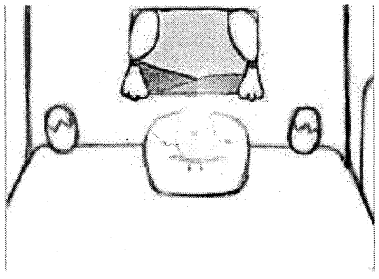

Figure 4 - The egg is hatching

Figure 4 –

Various types of baby chicks will appear based on the healthiness of the egg, which will indicate how well a player has controlled the plasma glucose level (Figure 5).

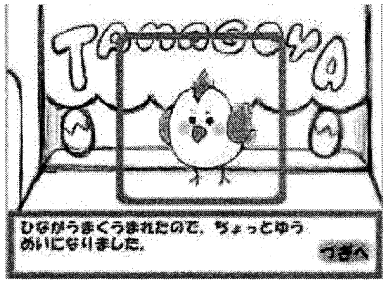

Figure 5 - Successfully hatched egg

2) Tantei (Detective)

The Detective is designed for patients who already have basic knowledge about type-1 diabetes mellitus.

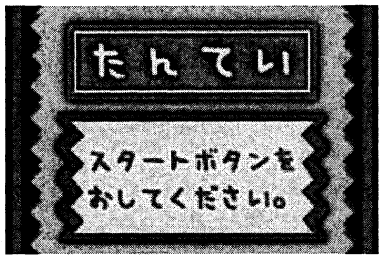

Figure 6 - Introduction of the "Detective"

A player becomes a detective who chases a criminal in the game. The detective has type-1 diabetes mellitus, and needs additional diets and insulin shots during the chase. The food and insulin can be found on the way to chase the criminal. A player needs to select either foods or insulin based on current plasma glucose level shown on left side of the screen (Figure 7).

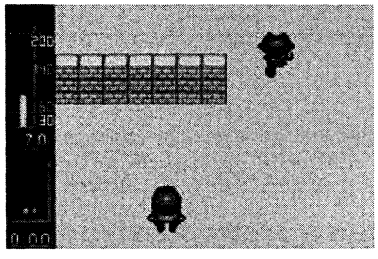

Figure 7 - Main Screen of the "Detective"

During the chase, a player also faces a quiz (Figure 8). A player can take short cut if she/he answers correctly. The quiz includes a variety of questions related to type-1 diabetes mellitus.

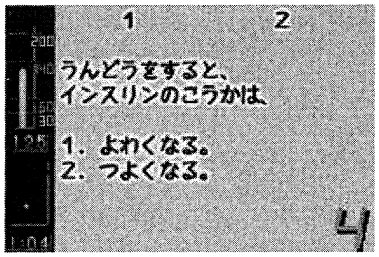

Figure 8 - Quiz Screen of the "Detective"

If a player forgets to control plasma glucose level, the screen is fogged to alert that the plasma glucose level is out of control. This also provides information that plasma glucose level finally influence on vision (Figure 9).

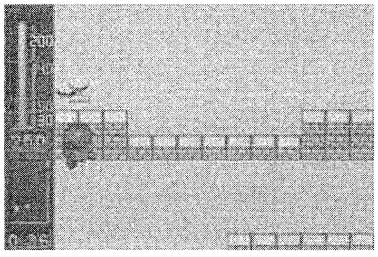

Figure 9 - Fogged Screen due to hyperglycemia

3) Magic Toom (Buildup blocks)

The Buildup Blocks is designed for patients who need to learn which food to be selected in a variety of situations (Figure 10).

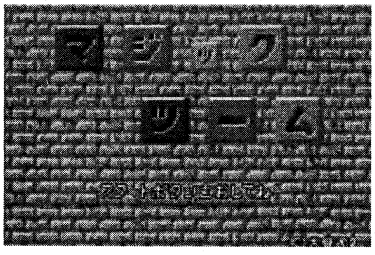

Figure 10 - Initial Screen of the "Buildup Blocks"

A player is assigned a task to buildup colored blocks according to directions provided by the game . A plasma glucose level with its velocity of plasma glucose change is displayed on the left upper side of the main game screen. A player needs to choose between the foods appearing in the left lower side based on the information on the screen. For instance, a player needs to select a food which contains higher carbohydrates at the beginning of the game to start the hard work. In case of hypoglycemic event, a player needs to select a food or supplement which has a high glycemic index (Figure 11)

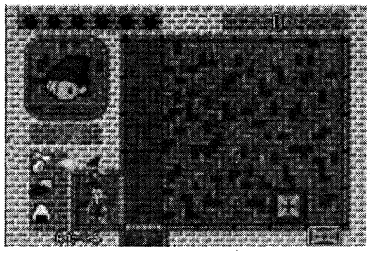

Figure 11 - Main Screen of the "Buildup Blocks"

The game notifies the player if plasma glucose level is decreasing (Figure 12).

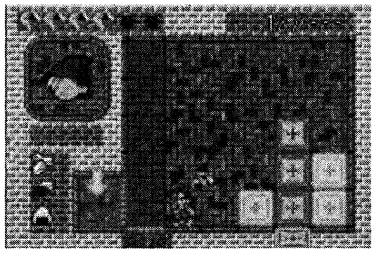

Figure 12 - Screen at the event of hypoglycemia

Evaluation

Entertainment

Generally, most testers felt that these games are fun (Q1) and wanted to play again (Q2). Out of total 58 testers, 15 (25.9%) answered they strongly agreed that they want to recommend the games to their diabetes friends, and 16 (27.6%) agreed, respectively (Q4). Seventeen (29.3%) and 20 (34.5%) strongly agreed and agreed to recommend the games to their nondiabetes friend, respectively (Q5).

Usability

Both characters and images in the games are easily recognized (Q6 and Q7). The handling of the games was straightforward and intuitive (Q8). Most testers seemed to have no tro uble playing the game without any instruction by observers. Since action games (i.e. detectives and block action) require complicated manipulations, overall score for Q9 and Q10 is lower in those games.

Clinical usefulness

Fifty-three testers out of 58 (91.4%) showed an interest in edutainment approaches for healthcare education. The overall score is very high in this question (Q11). More than 60% of testers (35/58) strongly agreed or agreed that an edutainment approach would be a useful initial education tool for type-1 diabetes children (Q12). Overall, if the games reflect a real diabetes situation lower scores appear since only general information and knowledge were provided. Most tes ters wanted to have individualized

education tools which reflect their own conditions (Q13). Table 2 reveals the result of evaluation.

Table 2: Result of Evaluation (5= Strongly Agree to 1=Strongly Disagree)

Q	Mean Score of 1-5 scale			
	Egg breeder	**Detective**	**Buildup blocks**	**Average**
No.	(n=21)	(n=18)	(n=19)	(n=58)
Degree of entertainment				
1	4.00	4.11	3.89	4.00
2	3.33	3.61	3.95	3.63
3	2.62	3.11	2.16	2.63
4	3.70	3.71	3.63	3.68
5	3.67	3.76	4.21	3.88
Usability				
6	4.24	4.00	3.33	3.86
7	4.52	4.22	3.16	3.97
8	4.48	3.94	3.21	3.88
9	1.43	2.44	3.05	2.31
10	1.48	3.12	2.37	2.32
Clinical usefulness				
11	4.57	4.35	4.53	4.48
12	4.05	3.47	3.56	3.69
13	3.38	3.29	3.21	3.30

Discussion

We have developed three different games as examples of edutainment tools for type-1 diabetes children. The evaluation showed that these games provide fun and entertainment with learning. All three games are easy to use and intuitive.

The one most important message delivered in these games is the affirmation that all type-1 diabetes patients can do anything they want as long as the patient uses insulin properly and keeps an appropriate plasma glucose level. The game included many options for exercises and plays, so that patients can understand this message.

Another important but difficult issue for the edutainment system is a balance between education and entertainment. If the game has too much fun without appropriate contents, it can not be called a learning tool. However, the system does not appeal if education is too much emphasized. If it is not fun, it can be called neither "entertainment" nor "game".

The game development team faced many problems related to medical disciplines during the developmental stages. Although some healthcare professionals supported the development activities, many had difficulty understanding the logic behind game development. Therefore, we desired personnel who understood both languages in healthcare and game development.

It is important to foster the development of professionals who can produce interdisciplinary research and development, which combine various disciplines to generate marketable and medically significant products, especially in the health informatics area.

Conclusion

Our study showed that edutainment system could have significant potential for healthcare education especially for children. The balance between entertainment and learning is a critical factor in developing attractive and effective learning tools.

Acknowledgement

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