

# EFFECTIVENESS OF “DM WONDER TRIP” – A NEW EDUCATIONAL TOOL FOR TYPE 1 DIABETES

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**Abstract.** The interactive education tool “DM Wonder Trip” is a combination of the board games, Monopoly and Snakes and Ladders. It is designed for type 1 diabetes patients (T1D) and their families to enhance their knowledge and self-management skills toward improving self-care and preventing acute complications. We developed DM Wonder Trip, and evaluated its entertainment value, usability, and clinical usefulness. The 107 study participants comprised 53 T1D patients (aged 8.2–25 years; the game players), 44 caregivers (the observers), and 10 physicians (the game leaders). DM Wonder Trip is a board game that uses cards to educate participants about diabetes, especially the self-care-skills, problem-solving, and daily-decision-making aspects. After playing the game for 30 minutes, all participants completed questionnaires. Among the 3 groups of participants (patients, observers and physicians), the evaluation scores recorded for entertainment were 60%, 74% and 70%, respectively; for usability, 84%, 91% and 60%; and for clinical usefulness, 83%, 93% and 100%. All 3 groups of participants awarded the highest scores to the clinical-usefulness category. There were no statistically-significant differences among the variables and groups. We modified the game based on the participants’ evaluations and comments. In conclusion, the DM Wonder Trip educational tool can be used as part of diabetes self-management education; to confirm diabetes knowledge and self-management skills before hospital discharge; or to promote better relationships between health-care providers, patients, and families.

**Keywords:** diabetes education tool, type 1 diabetes, board game, interactive education, diabetes self-management education (DSME), diabetes self-management support (DSMS)

## INTRODUCTION

Type 1 diabetes mellitus results from autoimmune destruction of the  $\beta$ -cells of the pancreas. Its incidence varies among countries and ethnic

populations. The annual incidence rate of type 1 diabetes among Thai children and adolescents is lower than in western countries, but similar to those reported in other Asian countries (Tuchinda *et al*, 1992; Tuchinda *et al*, 2002).

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Appropriate education is important for type 1 diabetes patients, their parents, and family members to develop the requisite skills, the abilities to deal with emergencies, and an awareness of proper health behaviors. Patients need to undertake an education program on proper insulin therapy and injection techniques;

blood-glucose monitoring; diabetes nutrition; healthy exercise; the management of special occasions, such as travel or social events; and dealing with illnesses. Many countries have established programs to teach diabetes patients; examples are the National Standards for Diabetes Self-Management Education (DSME) and Diabetes Self-Management Support (DSMS) (Haas *et al*, 2014). Position Statements on Structured Education (Department of Health and Diabetes UK, 2005), and Guidance on the use of patient-education models for diabetes (National Institute for Health and Care Excellence, 2015).

At Siriraj Hospital in Bangkok, Thailand we have developed a pediatric diabetes self-management education program. To achieve a holistic education, the program draws upon contributions from pediatric endocrinologists, diabetes nurses, dietitians, and clinical psychologists. Under this program, the patient and at least one family member are required to attend program sessions that are held upon hospital admission for diabetic ketoacidosis (DKA), after recovery, and either for a further period of 7–10 days or until the family member feels comfortable with the program. As has been observed in similar programs in other countries, our previous studies have indicated that appropriate initial education leads to noticeable improvements in patient-self-confidence, positive behavioral changes, and reduced levels of HbA1C and recurrent DKA (Likitmaskul *et al*, 2002; Santiprabhob *et al*, 2007).

In parallel with this program, we have held a diabetes camp for type 1 diabetes patients since 1990 (Likitmaskul, 2006; Santiprabhob *et al*, 2008). Every year, the patients and their families participate in a self-help group called the Thai Diabetes Child and Adolescent Club, which involves various activities and the sharing of experiences (Thai Diabetes Child and Adolescents Club, 2015).

In the case of children, however, conventional

learning – either in small-group lectures or individual discussions – rarely has elements of fun and interactivity, and they have thus found such efforts boring.

As outlined in the theory of intrinsically motivating instruction (TIMI), elements such as fantasy, curiosity, and challenging learning activities help people develop intrinsic motivation, positively change their behavior, and instill the desire to improve their well-being (Matheson and Spranger, 2001). One example of this is INSULOT, a cellular-phone-based, edutainment learning tool developed for children with type 1 diabetes, and used in some countries (Aoki *et al*, 2005).

Along these lines, we believed that a board game could provide dynamic interaction between the educator and learner, and thereby provide a cost-effective means of presenting an individualized learning program. A board game has already been used as the primary prevention strategy for educating school children about the risk factors associated with heart disease and cancer, and an experimental group was observed to achieve significant gains in knowledge (Bartfay and Bartfay, 1994). A board game has also been developed and published on the Internet for use by parents as a tool in teaching their children about type 1 diabetes (Hollenberg, 2008).

As a part of an undergraduate thesis, we designed and developed the first, Thai-language board game as an education tool for teaching type 1 diabetes children in Thailand about diabetes and nutrition (Chitcharoen *et al*, 2010). The present study examines a refined form of that first board game.

To improve the focus of the original game on health education, diabetes self-management, and problem-solving skills, we added content related to general ideas about diabetes, healthy foods and exercise, insulin, and controlling plasma glucose levels in type 1 diabetes patients.

We evaluated the modified board game's entertainment value, usability, and clinical usefulness.

## MATERIALS AND METHODS

### Team development

Three development teams (Division of Endocrinology and Metabolism, Department of Pediatrics, Siriraj Diabetes Center; Faculty of Medicine Siriraj Hospital; and Department of Nutrition, Faculty of Public Health, Mahidol University) developed a board game called DM Wonder Trip, which built on the earlier work of Chitcharoen *et al* (2010). Each development team added to the content of the game in terms of diabetes knowledge - particularly patient self-care skills, problem solving, and decision making for both daily diabetes care and emergency management.

After the study, participants completed an initial evaluation of the game, and some of its features were adjusted. In particular, we changed the cards used in the game and modified its rules and instructions (such as its purpose, the guides for players and educators, techniques for understanding the game's characters, rules related to its tools, and techniques for educators to solve the game's problems). Finally, the players

and educators completed a questionnaire, and the new version of the game entered its second phase of development.

The patients who were invited to participate as players had had diabetes for over 6 months, and had either attended the Siriraj Hospital's diabetes camp or presented at Siriraj Hospital's diabetes mellitus (DM) clinic during the study period. The patients' parents were also requested to attend as observers. As well, the health-care professionals who had attended the camp were invited to take part in this study as observers.

The game leader was an educator, who reviewed the rules of the game, monitored the players as they played, and dealt with any answers that arose during the game. The players were the type 1 diabetes (T1D) patients, who played the game and interacted with the game leader. The role of their parents and the health-care professionals was to watch the actions of the players and game leaders during the game, and assess the atmosphere during the period of play.

### Study participants

Over a 2-month period, this study recruited 107 participants (53 T1D patients, 44 observers, and 10 physicians) from the 12<sup>th</sup> DM camp as well as patients who had attended the diabetes

Table 1  
Characteristics of the type 1 diabetes patients (N=53).

Gender, number (%)	
Male	27(51)
Female	26(49)
Age, years	13.7 ± 3.4
Weight, kg	49.9 ± 14.5
Height, cm	154.7 ± 12.6
HbA1C, %	9.6 ± 2.7
Age at diagnosis of diabetes, years	8.4 ± 3.9
Duration of disease, years	5.2 ± 3.9

Data are presented as frequency (percentage) or mean ± SD.

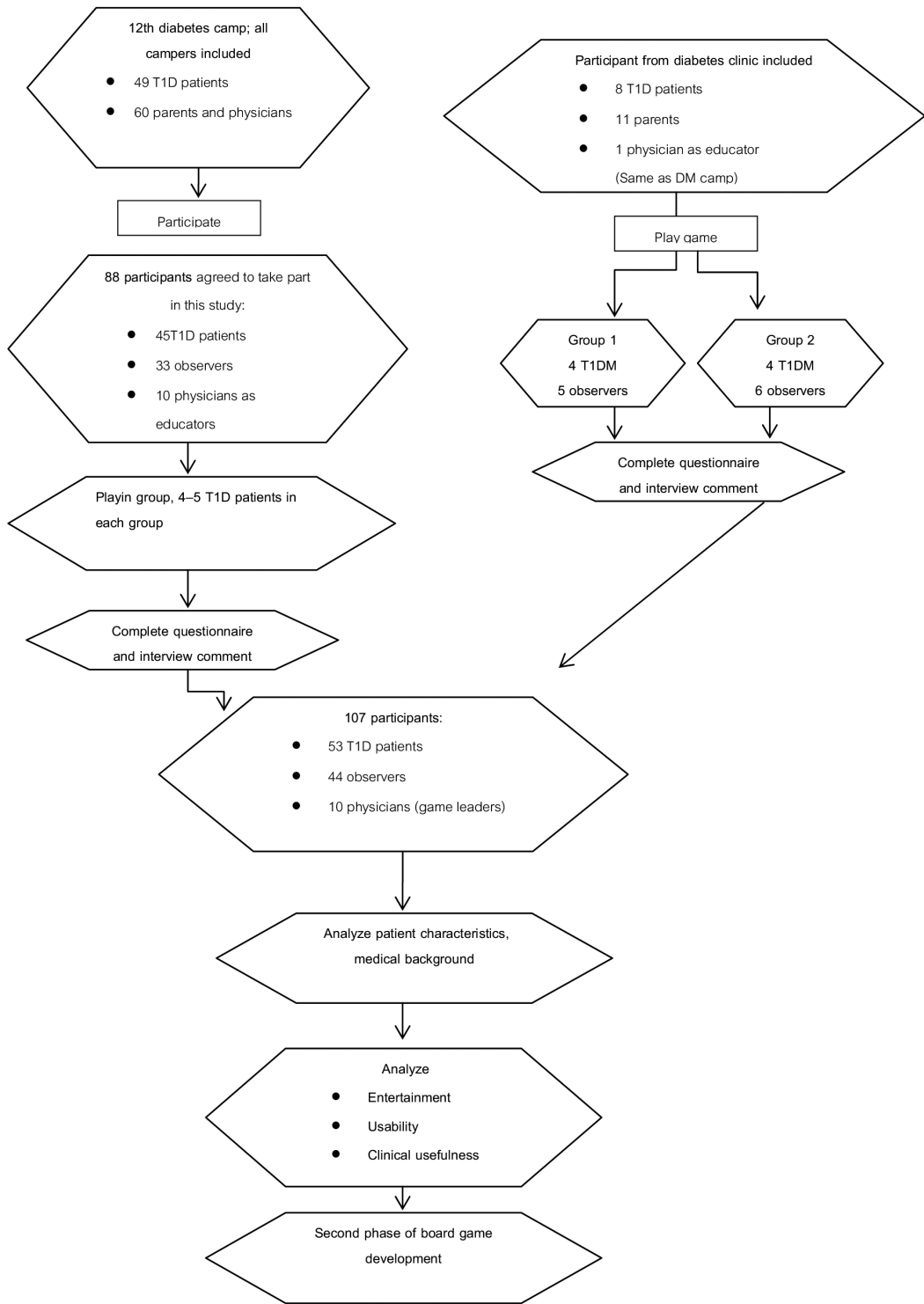


Fig 1– Flow diagram showing subject recruitment and retention.

self-management education and skills course at the pediatric DM clinic at Siriraj Hospital. The characteristics of the 53 T1D patients are presented in Table 1, and Fig 1 shows a flow diagram of the study. We used consecutive and convenience sampling to recruit the study participants.

This study was approved by the Siriraj Regional Ethics Committee [098/2554 (EC2)], and all subjects gave their informed, written consent to participate.

### Evaluation

The participants had to complete questionnaires to assess the degree of entertainment, usability, and clinical usefulness of the game.

There were two versions of the questionnaire: one for patients and observers, and the other for physicians. Both versions had 17 questions related to entertainment, usability, and clinical usefulness. The questions are at Table 2; they were scored on a Likert scale of 1-5 (1, strongly disagree; 2, disagree; 3, neutral; 4, agree; and 5, strongly agree). We regarded scores of 4 or 5 as satisfaction with the related category.

We also interviewed all participants to obtain additional general comments about tools for T1D education.

### Statistical analysis

We conducted analyses using SPSS software, version 16 (SPSS, Chicago, IL). We employed the

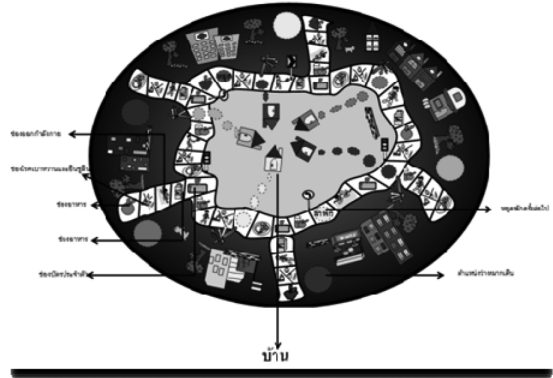
Table 2  
Questionnaire items.

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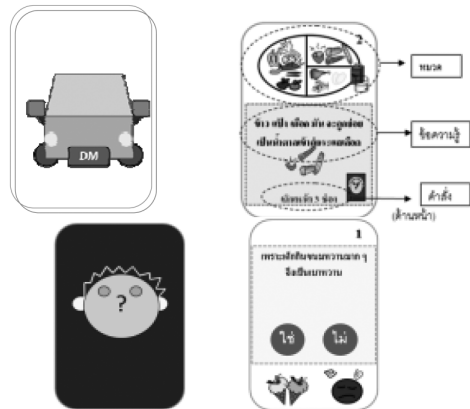
Entertainment value	
1.	Playing the game is fun.
2.	Playing the game is boring.
3.	I want to play the game again.
4.	I would recommend the game to non-diabetic friends.
5.	I would recommend the game to diabetic friends.
6.	The playing time is appropriate-not long or too short.
7.	Playing the game was a waste of time.
Usability	
8.	The game is easy to play, not complicated.
9.	The pictures are attractive.
10.	The size of the pictures is good.
11.	The characters are easy to read.
12.	The language is easy to understand.
Clinical usefulness	
13.	I thought that the game was useful for me.
14.	It would be useful to play the game at the beginning of my education about diabetes.
15.	The game gave me knowledge about taking care of my diabetes.
16.	The game includes situations that actually happen in my life.
17.	The game can help me to change my behavior in taking care of my diabetes.

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A. Appearance of the board game. Players start at one of the colored circles and move along the path. They finish at the house of the same color. To increase the fun, there are blocks along the path.



B. The action cards cover knowledge about diabetes, healthy foods and exercise, insulin, and controlling plasma glucose levels. At the bottom of each card appears the next step in the game, such as stop, advance three blocks.



C. Question cards: these feature questions about diabetes, and each card is different. The aim is to score a gift card. For example, children become diabetic through eating a lot of candy. YES OR NO?



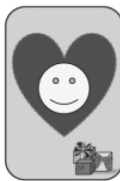
D. Gift cards are given to players who get the answer right. The front shows pictures of gifts. There are five different kinds of cards: "I can do" cards, happy cards, insulin cards, healthy food and exercise cards, and fortune cards (the latter are added to add fun appeal to the game).



Front



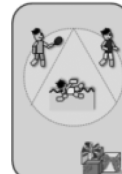
Back 4 points



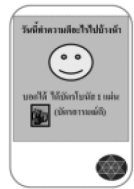
1 point



1 point



1 point



Fortune card

Fig 2– Trial version of DM Wonder Trip game: A, the first board game; B action cards; C, question cards; and D, gift cards.

chi-square test to assess the association between the usefulness or satisfaction and the particular clinical features. A  $p$ -value  $<0.05$  was considered statistically significant.

## RESULTS

### Description of the game

The game covers three topics related to diabetes education: general issues of diabetes; insulin and the adjustment of insulin-intake on certain occasions; and healthy diet and exercise. The first version of the board game can be played by up to five people. It consists of a single board and 218 cards of three different types: 67 action cards, 52 question cards, and 99 gift cards (Fig 2).

In each round, players pick up different types of cards. The first player picks up an action card, reads out aloud a sentence about diabetes knowledge, and moves his or her board-token along the path according to the directions on the card. The game leader can explain anything that the player does not understand.

The player then picks up a question card and answers the question, which could be about general matters related to diabetes, facts and myths about diabetes, or a problem-solving situation related to diabetes care.

If the player answers correctly, he can choose a gift card to collect points. One point is given for each healthy food card, exercise card, insulin card, and happy card; however, four points are given for the "I Can Do" card. Fortune cards are a kind of gift card: their function is to make the game more fun. If the answer is incorrect, the game leader can provide an explanation.

It is then the turn of the next player. The game ends when one player reaches the home position. The winner is the player with the most points.

### Evaluation

**Entertainment value.** The patients, observers, and educators assessed the degree of entertainment as 60%, 74% and 70%, respectively. They

gave the lowest score to question 4 ("I would recommend the game to non-diabetic friends").

There were no significant differences in HbA1c, age, duration of disease, and the initial age of diagnosis between the group that was satisfied with the tool and the group that was not (Table 3).

When evaluating the entertainment value of the game in question 4 ("I would recommend the game to non-diabetic friends"), the majority of patients gave a negative response, which produced the low score at Table 4.

**Usability.** Regarding convenience, 84%, 91%, and 60%, of patients, observers, and educators, respectively, found the game easy to play.

The educators' score was lowest for question 8 ("The game is easy to play, not complicated"); that implies that the rules of the game could be difficult to understand for observers, though not for patients (Table 4).

**Clinical usefulness.** Most participants agreed that the game was useful as a learning tool for T1D children: 83% of patients, 93% of observers, and 100% of educators rated it positively. In the subset-analysis, patients aged over 15 years gave full scores for usefulness. Female patients found the game to be more useful than males. There were no significant differences in the other variables between the group that felt the game to be useful versus the group that deemed it to be not useful (Table 5).

After finishing the game, patients and observers reported that the 30-minute playing time was too short. They wanted to play longer, gain more knowledge and have more fun.

### Second board game development

After the evaluation of the first board game, we made adjustments to the instructions, the board game, and the playing cards, as shown at Fig 3.

An evaluation of the second board game was

Table 3  
Variables that influenced game satisfaction in the patients.

Fun and satisfaction	Not satisfied %	Satisfied %	<i>p</i> -value
Gender			0.56
Male	44	56	
Female	36	64	
Age			0.62
8–12 years	44	56	
12–15 years	43	57	
>15 years	25	75	
Education			0.86
Primary school	36	64	
Secondary school	45	55	
High school and above	40	60	
Age at diagnosis of diabetes, years	7.7±3.2	8.5±4.3	0.47
Duration of disease, years	5.3±4.0	5.6±3.8	0.77
HbA1C, %	9.2±2.0	9.9±3.0	0.38

Table 4  
Game evaluation by group.

Game evaluation	Patients	Observers	Physicians
Fun and satisfaction	(30/50) 60%	(31/42) 74%	(7/10) 70%
Usability	(43/51) 84%	(40/44) 91%	(6/10) 60%
Usefulness	(43/52) 83%	(40/43) 93%	(11/11) 100%

made by the health-care team at a short course for diabetic health-care training; better scores were obtained for all three categories (Table 6).

## DISCUSSION

Diabetes self-management education (DSME) is like a weapon for diabetics striving to take care of themselves. Unfortunately, traditional teaching methods, such as lectures with papers, folders, and books, have limited appeal to children and adolescents owing to their short attention spans.

According to the core concepts of TIMI, fantasy, curiosity, and challenging learning-activities will make people develop intrinsic motivation, change their behavior, and increase their desire to improve their well-being (Matheson and Spranger, 2001). One study created a conceptual model for developing characters, game play, and behavioral procedures in the design of a video game to promote self-management among young people with T1D (Thompson *et al*, 2010). In the education process, if an educator has a game tool that can induce participants to



Table 5  
Variables influencing clinical usefulness among the patients.

Clinical usefulness	Not useful %	Useful %	<i>p</i> -value
Gender			0.01*
Male	29	71	
Female	4	96	
Age,			0.08
8–12 years	22	78	
12–15 years	22	78	
>15 years	0	100	
Education			0.25
Primary school	14	86	
Secondary school	27	73	
High school and above	6	94	
Age at diagnosis of diabetes, years	8.9±2.7	8.3±4.2	0.70
Duration of disease, years	3.6±3.4	5.7±3.9	0.15
HbA1C, %	8.3±1.7	9.8±2.7	0.14

\**p* < 0.05 is significant by the *t*-test.

Table 6  
Evaluation of the second version of the board game by health professionals and educators.

	Observers (Players)	Physicians and dietitians (Game leaders)
Fun and satisfaction, (%)	72.6	79.3
Usefulness, (%)	95.1	95.5
Usability, (%)	93.3	91.1

follow the learning sessions with enjoyment, excitement, and a competitive spirit, that may help them learn or understand more deeply in some contexts.

In this area, many education tools have been reported in the literature. (Gross-Schmidt, 2008; Kahol, 2011; Lieberman, 2012; Piziak, 2012). They include video games designed to improve and support the diabetes self-management of

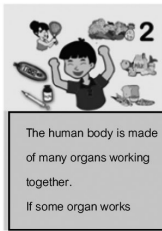
the players. Most of them were targeted at diabetics and obese people, and aimed to change their behaviors and lifestyles; however, they were not designed to be used by educators in training sessions. Only one education tool – The Diabetes Conversation Map – has been reported for diabetic children (Mochon *et al*, 2011). Although it has been successfully used worldwide by diabetes educators in training sessions, it lacks games features (Reaney *et al*, 2013).



A : a board game



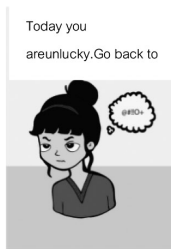
E : instruction book



B: action card



C : question card



D : gift card, "I Can Do" card, happy card, insulin card, healthy food card, exercise card, and fortune card

Fig 3– The second board game development: A, board game; B, action card; C, question card; D, gift card, "I Can Do" card, happy card, insulin card, healthy food card, exercise card, and fortune card; E, instruction book.

In the present study, we assessed our board game DM Wonder Trip, which is a combination of Monopoly and Snakes and Ladders. It is designed to be used by educators as an education tool, providing dynamic interaction between the educator and learners during a learning session. This study was not aimed to measure diabetic knowledge but rather to improve the skill of the patients to solve the problems encounter in everyday life. The pamphlets of diabetic knowledge are available for every patient and on action cards.

We found that most participants in the three groups (patients, observers, and physicians) rated the tool as useful; they believed it reflected situations that diabetics face in real life. It was particularly well-evaluated by physicians: their acceptance of its benefits was 100%. In terms of appreciation, the patient-group responded that they enjoyed the game and would introduce it to other diabetics (96.2%) but not to non-diabetic people (51.9%).

After finishing the game, several children asked if they could take the game with them to school so that they could play it there with their friends: that way, their friends could better understand T1D. We were surprised that patients aged over 15 years found the game to be more fun and more useful than younger ones. That would suggest that the older patients better understood the contents of the game.

In addition, several game leaders stated that the game allowed them to easily explain several areas of diabetes management, and they reported that the players appeared enthusiastic when learning about diabetes during the game. If educators using the game understand the nature of children and the concept of teaching with fun, this game could become a tool to promote open-minded participation and foster closer relationships between patients and educators.

Parents in the observer group reported that they would like to play the game at home with

their family members to help them learn about diabetes self-care. That led us to consider that we should make the instruction details more easily understandable by game leaders who are not educators (such as parents and friends), but who have attended our classes.

Games are an effective educational tool for teaching T1D children, and have the potential to improve children's behavior and self-monitoring. A study of the Didget blood test meter concluded that it helped children to develop good blood glucose monitoring habits, especially children who have knowledge but lack motivation (Klingensmith *et al*, 2013). By comparison, DM Wonder Trip is intended to develop knowledge, motivation, and problem-solving skills, and it was found to be useful as a learning tool (83% of patients, 93% of observers, and 100% of educators).

One study employed a robot to interact with children to promote health knowledge and self-management (Blanson *et al*, 2013). The robot played a diabetes-knowledge game with the children, and it was able to recognize each child's name, observe their emotional state, and recall previous interactions. The study found the robot to be a fun tool, and it provided motivation, but the children disliked both the need for them to repeat questions and the slow responses of the robot.

By contrast, our DM Wonder Trip is led by an educator who can ask and answer questions. The educator can interact with the players, stop the game, or change it, according to the dynamics of the game. Furthermore, some players and observers reported that the game has the potential to help children cope with the negative effects of their diabetes through discussions during the game.

One limitation of this study is the potential for bias. The participants may have been influenced by the researchers, who were their physicians. This study also had a small sample size, had no

pre-posttest of diabetes knowledge scores and there was no follow-up information gauging the effectiveness of the game with respect to clinical parameters.

In conclusion, the board game DM Wonder Trip could be another tool for integrated DSME, leading to self-management skills for T1D patients. It can also be used to enhance the relationships between health-care providers, patients, and their families.

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### CONFLICTS OF INTEREST

The authors declare no personal or professional conflicts of interest.

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