Effect of Education-Based Gamification Strategy through Snake Ladder Game on Children's Knowledge and Practices Regarding Insulin Self-injection

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Abstract

Background: Gamification itself has been widely used as an application in learning. Aim: To evaluate the effect of an education-based gamification strategy through a snake ladder game on children's knowledge and practices regarding Insulin Self-injection. Research Design: A quasi-experimental research design was used to conduct this study pre-and post-testing. Subjects: A purposive sample of 100 children with diabetes type 1 who are receiving insulin injections was recruited in this study from the previous setting. Setting: The study was conducted at Pediatric Diabetes Clinics at Mansoura University Hospital. Tools of data collection: Tool I: Structured questionnaire sheet, and Tool II: Observational Checklist for Reported Practice of Insulin Injection. Results: Findings revealed that there was a significant improvement in knowledge and practices regarding insulin self-injection among children post-gamification strategy through snake ladder game intervention as compared to pre-gamification strategy through snake ladder game intervention (p < 0.05). Conclusion: The result was concluded that implementation of the gamification strategy through the snake ladder game had a positive effect on improving children's knowledge and practices regarding insulin self-injection. Recommendations: Adopting gamification in the game of snakes and ladders is recommended as a medium of learning for children ages early to increase attractiveness, interaction, and understanding.

Keywords: Children, Gamification strategy, Insulin Self-injection, Knowledge and practices, Snake ladder game

Introduction

Type 1 diabetes (T1D) is a chronic autoimmune illness that is defined by hyperglycemia due to insulin insufficiency caused by pancreatic β-cell dysfunction. The cause of Type 1 diabetes mellitus is unknown although genetic, immunologic, and environmental factors are recognized to increase the risk of its occurrence (Ozen et al., 2020). It demands extensive self-care including multiple daily insulin injections, several finger-pricks daily for blood glucose testing, and venipuncture when attending the outpatient clinic. If the child is treated with an insulin pump, a change of needle is required at least every third day, and a change of a sensor is required once a week or fortnight for continuous glucose monitoring. Additionally, the international guidelines recommend venipuncture once a year to test, for example, blood lipids, thyroid function, and kidney function (Dai, B. et al., 2022).

The primary goal of diabetes management is to achieve the blood sugar level within the target range. To meet this target, an appropriate delivery of insulin is essential. Insulin is an effective drug for the control of blood sugar levels. Diabetes type 1 is a chronic condition that necessitates frequent insulin replacement and a strong patient regimen. The goal of treatment is to reduce hyperglycemia while lowering the chance of hypoglycemia. Exercise, insulin dosages, food, physical stress, and a host of other variables all impact the intricate glucose balance (ADA, 2022).

Type 1 diabetic children and teenagers can expect to live long, happy lives if they receive the right support and care. This exercise goes over how type 1 diabetes mellitus is diagnosed and treated in kids and emphasizes the need of interprofessional team members working together to deliver coordinated care and improve patient outcomes (ADA, 2022). When choosing an educational approach to teach insulin injection techniques to children, health professionals must consider engaging strategies for the pediatric population, such as the use of therapeutic play (La et al., 2020).

The use of gamification in education has become commonplace. According to earlier studies, using motivation and interest to boost learning is a crucial step in developing gamification strategies that will motivate behavior. Gamification techniques have been investigated as a learning tool in a variety of contexts, including the use of the Snake Ladder Game, animation, and foreign language learning. The results of these studies demonstrate a notable enhancement in learning outcomes (Warburton & Madge, 2019).

Previous studies have demonstrated a similarity: gamification techniques are frequently applied with success at educational levels. This occurs with kids such that the idea of gamification can be used more easily. For the lower level objects, notably early childhood education, it raises an issue about the appropriate gamification strategy assessment. Gamification is essentially a notion of strategy that combines aesthetics and games to encourage critical thinking, inspire learners of all skill levels, and address learning challenges. Furthermore, according to Golchhai et al. (2020), gamification tactics can also be particularly understood as the use of game media to boost social involvement and attractiveness.
In light of this, the concept of gamification is presented at this creative moment to address children's learning demands before they become urgent. A crucial aspect of implementing a gamification strategy is carefully choosing and embracing a universal game concept. It is universal only in the limited sense that it is a well-known game with simple, universal rules that are played by players of all ages. The findings demonstrated that Snakes and Ladders is a type of universal game that may be used to practice and modify concepts related to learning (Nachiappan et al., 2020).

In the educational domain, gamification strategies are typically employed to boost students' engagement and motivation for assigned work. According to Kaihara et al. (2021) improved learning outcomes can be achieved when students are actively engaged in the concept of gamification in lessons. Positive effects of gamification on education include raising student engagement and motivation in class, which will subsequently improve conduct and grade acquisition. Values are examined from a point of view and the sequence in which they are reached as levels in the educational system through gamification. Challenges and quests that require participants to complete tasks in order to be motivated; and a competition that enables coaches to complete tasks more quickly or effectively are a few examples of how gaming aspects can be incorporated into learning; cooperation encourages participants to work together and collaborate for better results (Höchsmann et al., 2019).

Serious learning or instructional games are not the same as the concept of gamification. Gamification has been rapidly adopted in the business, education, and health sectors in recent years. This is motivated by the possibility of influencing user behavior in the intended way. Gamification is a word that encompasses more than just applying in-game aspects outside of games. But the term "gamification" refers to a combination of ideas that include using games to provide information while also motivating users to solve challenges, feel good, receive immediate feedback, and progress cognitively through the inserted content. Gamification is a technique that draws inspiration from games to create engaging experiences across a variety of industries, such as education and economics (Shitiq, & Mahmud, 2020).

The game snake ladder is an alternate learning medium that can help children surpass their learning objectives. Because of its simple and thrilling rules, students might become enthused about playing the snake ladder game, which can be turned into an effective teaching tool (Lalos et al., 2019). Snakes and ladders are a well-liked and popular play activity among kids, teens, and even adults, claim Shitiq & Mahmud (2020). Snake ladder games have the following benefits for learning: (1) students' attention spans will get shorter; (2) affective content will get bigger; (3) students' play, discussion, and questioning will demonstrate their psychomotor skills; and (4) they will create a more enjoyable learning environment.

Ibam et al. (2018) state that learning with snake ladder media can enhance students' cognitive capacities to handle learning challenges. The employment of snake ladder media can help youngsters develop their knowledge and learning, as explained by Ramakrishna (2019). Additionally, the use of snake ladder media can alter the learning process's experience. A small technological bundle will make the game more enjoyable.

Nurses have an important role in the management of diabetes. The nurse has the responsibility of teaching the self-injection of insulin to the patient and the family members or significant others and she has to begin this as soon as the need for the insulin has been established and use written or verbal instructions and demonstration techniques for teaching the patient (Chiang et al., 2019).

Significance of the study

Type 1 diabetes (T1D) According to the International Diabetes Federation (IDF) increases by about 3% per year among children of preschool age. It is added this index the improper and late diagnostics, causing major consequences to the child (IDF, 2021). In Egypt 8 out of 100,000 children under the age of 14 have type 1 diabetes (WHO, 2018). Type 1 diabetes mellitus can occur at any age but it is the most common metabolic disease in children and youth (Kipasika et al., 2020).

According to Amin et al. (2020), the purpose of the snake ladder game is to allow students to repeat or learn previously covered material in an engaging fashion by using games as a means of assessment. According to Baiquni (2016), students who use the snake ladder game will be more actively searching for and discovering a learning concept by moving closer to the real surroundings, thereby maximizing the concept of science learning that brings the environment closer to learning resources. According to recent research, gamification and gaming can help people adopt better self-management practices (Kerfoot et al., 2019).

Gaming/gamification involves the use of game design elements to engage patients in health promotion efforts.10 Gamification may involve competition to further enhance engagement. Gamification uses technology as an educational tool and offers the patient a “fun” way to engage in the acquisition of knowledge while addressing and supporting behavioral change (Martos-Cabrera et al., 2020). Several systematic reviews have been done evaluating the use of gaming to improve knowledge and self-management among pediatric patients with asthma, cancer, and type 1 diabetes (T1DM); games and health education in persons with T1DM and T2DM; gaming applications in cardiovascular disease; and diabetes gamification among people with
T1DM and T2DM with reported improvement in knowledge and self-management (Davis et al., 2021).

Research hypothesis

Education-Based Gamification Strategy through the Snake Ladder Game has a positive effect on diabetic type 1 children's insulin self-injection knowledge and practice.

The study aimed to:

Evaluate the effect of education-based gamification strategy through snake ladder game on children's knowledge and practices regarding Insulin Self-injection

Design

A quasi-experimental research design was used to conduct this study (one group pre-posttest)

Setting

The study was conducted at the Pediatric Diabetes Clinic at Mansoura University Hospital, working on Saturday weekly. The diabetic clinic receives new cases that need the confirmation of diagnosis and cases for follow-up of diabetic children.

Subjects

- A purposive sample of 100 children with diabetes type 1 who are receiving insulin injections was recruited in this study from the previous setting.

Sample size calculation

Based on data from the literature (El-Kurdy et al., 2017), considering a level of significance of 5%, and power of study of 80%, the sample size was calculated using the following formula:

\[ n = \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times (2 \times SD)^2}{(\text{mean difference between the two groups})^2} \]

Where

- \( Z_{\alpha/2} \): This depends on the level of significance, for 5% this is 1.96
- \( Z_{\beta} \): This depends on power, for 90% this is 0.94
- \( SD \): Standard deviation

Therefore,

\[ n = \frac{(1.96 + 0.94)^2 \times (2 \times 15.102)^2}{(5)^2} = 67.90 \]

Based on the above formula, the sample size was 100.

Inclusion criteria for children
- Children with type 1 diabetic
- Children of both sexes.
- Children aged less than 15 years old

Tools of Data Collection

- Two tools were used to collect the required data for this study.

Tool one: Structured interview questionnaire

It was designed by the researchers after reviewing the relevant literature and was written in simple language. It includes two sections:

Section (1): Demographic data of diabetic type 1 child:

This section was designed to evaluate the age, gender, educational status, family history of diabetes, and length of diabetes mellitus of the children enrolled in the study.

Section (2): Knowledge questionnaire about children with diabetes who self-administer insulin.

It was made by (Vimmerstedt, 2006) and covered the following subjects: Recognizing the fundamentals of insulin administration (5 questions), insulin self-administration sites and techniques (7 questions), insulin administration challenges (6 questions), and insulin administration safety measures (5 questions). There are 27 multiple-choice questions in these children's knowledge assessment items.

Scoring system of knowledge

Children's knowledge was graded, and one point was awarded for a correct response. The partial or erroneous response received a zero. When calculating the total replies scores, the "do not know" response was regarded as improper and received a zero. The total knowledge satisfaction level was divided into two categories based on the children's replies: satisfactory for answers that were correct 60% of the time or more, and unsatisfactory for answers that were incorrect less than 60%.

Tool II: Observational Checklist for Reported Practice of Insulin Injection

It was adopted from the American Association of Diabetes Educators, (2020) to assess the studied children's reported practice regarding their insulin injection. The procedure consists of 23 steps that are required to perform the self-insulin administration by children; this checklist is concerned with insulin preparation and injection.

Scoring System of Observational Checklist

The correct practice was scored as (1) and the incorrect practice was scored as (zero). The total practice scores were calculated as follows: The percent of total practice scores equal to 75% and above was considered competent level and less than 75% was considered incompetent (Atalla, 2016).

Field Work

Data was collected through the following phases

1. Preparatory phase

- Before starting this study, formal administrative approval was taken from the setting of the study. Permission was obtained from Mansoura University Hospital, with official permission from the managers of the outpatient clinics.
- Initially, the first researcher created a pleasant relationship with the diabetic children by engaging in brief conversations.
- The first researcher interviewed the diabetic children to collect baseline data (pre-test). At the beginning of the interview, the researcher explained the purpose of the research, provided them with all the information about the study research (purpose and duration), and obtained their oral consent to participate in the study.
Tools validity and reliability
The tool was tested for content validity by a jury of three experts in the field of pediatric nursing staff professors who reviewed the instruments for clarity, relevance, comprehensiveness, understanding, applicability, and easiness, in establishing the reliability and statistically done Alpha Cronbach way to check the stability of the internal consistency of the instrument I was 0.856 and instrument II was 0.943.

Administrative Design and Ethical Consideration
- The research proposal was approved by the Ethical Research Committee in the Faculty of Nursing at Mansoura University. Official permission was obtained through an issued letter from the Dean of the Faculty of Nursing, Mansoura University to conduct this study. An informed consent form was taken from the children's parents. The objective of the study was explained to the parents and children first before starting the study. The researcher informed the parents and children that the study was voluntary, they were given a right to refuse to participate and they had the right to withdraw from the study at any time, without giving any reason. Moreover, they were assured that their information was confidential and was used for research purposes only.

A pilot study
It was carried out on 10% of the selected sample (10 children with diabetes type 1) to test the clarity and applicability of the tool. No modifications were carried out. Children with diabetes type 1 who were in the pilot study were included in the main study.

2. Implementation phase
Official permission was taken from the Dean of the Faculty of Nursing and the director of the Mansoura University Children's Hospital, as well as the manager of outpatient clinics, in which the study was conducted. Oral permission was taken from the parent of the child after explaining the purpose and nature of the study.

The producer consists of 4 phases

First phase: Select a group of children that taught them, it has lasted about 7 weeks

Second phase: Assessed knowledge and practice of insulin self-injection, it has taken about 4 weeks

Third phase: Education-based gamification strategy through snake ladder game of insulin self-injection was performed for the studied children. Regarding practices: The researcher presented the materials they would use for the injection: a rag doll, a cotton ball with 70% alcohol, a sharps disposal box, a cool box, an insulin syringe with a real needle, and a vial (10 ml) or an insulin pen (with pen needle according to the child's usual insulin delivery modality). After demonstrating all the steps of injection into the doll, the researcher offered every child the chance and opportunity to inject the doll as it was demonstrated. This phase takes about three months.

Fourth phase: Evaluate the knowledge and practices of diabetic children regarding insulin self-injection after an education-based gamification strategy through a snake ladder game.

- The game was built with 100 squares and 50 questions about diabetes and insulin self-injection. The game was tested and put into play. With a 45-minute time limit, the students competed in seven-member groups.

- The participants had to provide their oral responses to the questions, which were formatted as flash cards and pictures. The questions were placed in three envelopes according to their taxonomy and graded according to difficulty, after which the students were instructed to select the questions at random. The questions' level of difficulty in the created game was indicated by the squares: The questions in the squares featuring snakes had an intellectual difficulty level of one, the questions in the squares with ladders had an intellectual difficulty level of three, and the questions in the remaining squares, which occurred once every three squares, had an average difficulty level of two. The game has fifty questions. Of those, twenty-five percent, forty-three percent, and, there were (20.45 %), (43.18 %), and (36.36 %) questions with difficulty grades of 1, 2, and 3, respectively.

- Rules and conditions: When a learner answers a question successfully, they advance in the game; but, if they don't know the answer to a question with a difficulty level of 1 (also known as a taxonomy grade 1), they go to the lower square. When faced with questions that have a difficulty level of 3 (taxonomy grade 3), the right answer advances them to the upper squares; however, the incorrect answer subject them to the following conditions (if they are unable to answer the question by using the specified conditions, they lose and are forced to exit the game): The questions have three difficulty levels (three being very difficult), two average, and one easy. Participants can leave answers to any of the three questions, but they will not be able to continue the game if they run out of time to use the conditions.

- A gift is given to a child in appreciation for being the first to reach the 50th question which is the last box. Following three weeks of nonstop play, each group of kids took a post-test to gauge their knowledge and reported practices. All activities of the fourth phase lasted about 8 weeks.
3. Evaluation phase
The evaluation was done using the study pre-test tools post 3 days following the pre-test assessment. The collection of data and implementation of the gamification strategy started in the last week of February 2023 and ended in October 2023.

Statistical analysis
Data entry and statistical analysis were performed using SPSS for Windows, version 20. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables and mean and SDs for quantitative variables. Differences between two means tests (t-test) were used. Statistical significance was considered at P-value <0.05.

Results
Table (1): Shows that 36% of the studied children with diabetes type 1, their age was 10 years, 53% of them were boys, and 80% of them were in primary education.

Figure (1): Illustrates that 60% of the studied children with diabetes type 1 had a family history of diabetes.

Figure (2): Illustrates that 60% of the studied children with diabetes type 1 under study had DM from 3-5 years.

Table (2): reveals that there were highly statistically significant differences in the studied children with diabetes type 1 mean score knowledge regarding Insulin Self-injection at P (<0.001) pre & post-gamification strategy through snake ladder game implementation.

Table (3): Demonstrates that, following the deployment of a gamification method using a snake ladder game, 85% of the children with type 1 diabetes who were tested had satisfactory knowledge levels about insulin self-injection, whereas 88% of them had unsatisfactory levels during the pre-implementation of gamification strategy.

Table (4): shows that, both before and after the introduction of the snake ladder game as a gamification method, there were highly statistically significant variations in the reported practices of insulin self-injection among the children with diabetes type 1 who were evaluated.

Data

<table>
<thead>
<tr>
<th>Age (in years)</th>
<th>Interventional Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>12 (12)</td>
</tr>
<tr>
<td>9</td>
<td>22 (22)</td>
</tr>
<tr>
<td>10</td>
<td>36 (36)</td>
</tr>
<tr>
<td>11</td>
<td>8 (8)</td>
</tr>
<tr>
<td>12</td>
<td>2 (2)</td>
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<tr>
<td>13</td>
<td>14 (14)</td>
</tr>
<tr>
<td>14</td>
<td>4 (4)</td>
</tr>
<tr>
<td>15</td>
<td>2 (2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Interventional Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>53 (53)</td>
</tr>
<tr>
<td>Girls</td>
<td>47 (47)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Educational status</th>
<th>Interventional Group (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary education</td>
<td>80 (80)</td>
</tr>
<tr>
<td>Preparatory education</td>
<td>20 (20)</td>
</tr>
</tbody>
</table>
Figure (1): Children with Diabetes Type 1 Distribution Regarding Family History of Diabetes (n=100)

![Pie chart showing distribution of family history of diabetes among children with diabetes type 1.]

40% Yes 60% No

Figure (2): Children with Diabetes Type 1 Distribution Regarding their Duration of DM (n=100)

![Bar chart showing duration of diabetes among children with diabetes type 1.]

20% More than 5 year 60% from 3-5 15% from 1 to 3 5% Less than one year

Table (2): Differences in Mean Score Knowledge between Pre-and Post-Gamification Strategy through Snake Ladder Game Regarding Insulin Self-Injection among Children with Diabetes type 1 (n=100)

<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Pre-Gamification Strategy</th>
<th>Post-Gamification Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsatisfactory</td>
<td>88 (88%)</td>
<td>15 (15%)</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>12 (12%)</td>
<td>85 (85%)</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>24.64±3.22</td>
<td>35.76±4.57</td>
</tr>
</tbody>
</table>
Figure (3): Total Knowledge Level Regarding Insulin Self-Injection among Children with Diabetes Type 1 Pre & Post- Gamification Strategy through Snake Ladder Game Implementation (no=100)

Table (3): Differences in Mean Score Practices between Pre-and Post-Gamification Strategy through Snake Ladder Game Regarding Insulin Self-Injection among Children with Diabetes Type 1 (no=100)

<table>
<thead>
<tr>
<th>Level of practices</th>
<th>Pre-Gamification Strategy</th>
<th>Post-Gamification Strategy</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incompetent</td>
<td>89 (89)</td>
<td>5 (5)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Competent</td>
<td>11 (11)</td>
<td>95 (95)</td>
<td></td>
</tr>
<tr>
<td>Mean±SD</td>
<td>117.49±12.84</td>
<td>154.94±9.26</td>
<td>10.78</td>
</tr>
</tbody>
</table>

Figure (4): Total Reported Practice Level Regarding Insulin Self-Injection among the Studied Children with Diabetes Type 1 Pre & Post- Gamification Strategy through Snake Ladder Game (n=100)
Table 4: Correlation between Total Knowledge and Practice Scores of the Studied Children with Diabetes Type 1 Pre & Post- Gamification Strategy through Snake Ladder Game Implementation

<table>
<thead>
<tr>
<th></th>
<th>Total Practice scores</th>
<th>Total knowledge scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-Gamification Strategy</td>
<td>Post-Gamification Strategy</td>
</tr>
<tr>
<td>R</td>
<td>-0.100</td>
<td>0.924</td>
</tr>
<tr>
<td>P – value</td>
<td>0.478</td>
<td>0.000**</td>
</tr>
</tbody>
</table>

Discussion

Type 1 diabetes is a difficult condition to manage for both individuals and families, requiring a great deal of knowledge and expertise (Allen et al., 2018). Enhancing self-belief in one's capacity to participate in health-promoting activities in line with managing type 1 diabetes is a serious goal (Whittemore et al., 2019). In order to boost students' enthusiasm and engagement in learning tasks, gamification approaches are commonly employed in education. Improved learning results may result from students' engagement with the gamification concept in educational activities. Gamification has the potential to improve student enthusiasm and engagement in class, which will subsequently improve grade acquisition and have a good behavioral impact (Ibam et al., 2019). Values are viewed from a point of view and their progression as stages in the educational system through gamification. A few instances of using game elements in education are levels that show participant status, rankings, and progress; challenges and quests that require motivation from participants; a competition that enables coaches to complete tasks more quickly or effectively; cooperation, which pushes participants to cooperate for better outcomes (Amin et al., 2020).

A health education model called snakes and ladders has never been extensively used. The reason the snake and ladder game was chosen as the educational tool was that it featured a range of pictures within boxes. This game is played with dice, pawns, and 36 pictures on a single sheet of paper. To assess the impact of an education-based gamification technique on children's knowledge and practices about insulin self-injection, researchers used the snake ladder game.

The current study's findings regarding children's demographics showed that just over one-third of the youngsters under investigation were 10 years old. Gender-wise, the findings showed that over half of the kids under study were male. The findings of this investigation aligned with the findings of Noorani et al. (2019), who noted that children with diabetes mellitus tend to be male. According to El-Ziny et al. (2019), the incidence and prevalence of T1DM were greater in females in Egypt, which runs contrary to the findings of this study and other studies.

The current study's findings demonstrated that, both before and after gamification of the insulin self-injection technique through the use of the snake ladder game, there were highly statistically significant variations in the investigated children with diabetes type 1 mean score knowledge. The application of the snake ladder game demonstrated, in the researchers' opinion, the benefits of the gamification strategy. Research by Hamdalah (2019) revealed that the kinds of media utilized during the learning process could have an impact on knowledge and attitude. It was anticipated that using the Snakes and Ladders game to teach health lessons would increase students' understanding of and attitudes toward leading healthy lives. The findings aligned with Blakely's (2020) study, which discovered that playing the snakes and Ladders game once could boost knowledge and attitude. Since educational toys are beneficial in promoting learning, particularly knowledge acquisition.

Likewise, Green, (2019) asserts that the predisposition elements that can influence knowledge include attitudes, beliefs, views, and information ever acquired. When the respondents engaged in direct participation in the activities and communicated with one another, there was an increase in knowledge through triggering. Using this approach, the respondents had the opportunity to voice their opinions about the conditions among their fellow students. According to a study by Siyam (2019), children ages 8 to 11 might score higher on the posttest when they played the snake and ladder game, which corroborated these findings. From the perspective of the researchers, it was observed that children could see, move, and engage with one another through play, which stimulates their curiosity and interests. The games visually appealing and easily comprehensible graphics were created with appropriate guidelines and aesthetics in mind.

As regards the current study's findings, most of the children with type 1 diabetes who were studied had inadequate knowledge of insulin self-injection on the pretest, but after using a gamification strategy involving the implementation of a snake ladder game, the majority of them had satisfactory knowledge. The efficiency of the snake ladder game, as perceived by the researchers, supported the necessity for gamification among the
children under study. Additionally, Rahina (2019) noted that engaging media, like the snakes and ladders game, creates a fun learning environment and increases the likelihood that students will retain the material. The fact that the students may play the game on their own and as frequently as they pleased increased their exposure to the content.

The current study's results showed that the reported practices of the examined children with type 1 diabetes regarding insulin self-injection before and after gamification through the use of a snake ladder game were significantly different, both statistically and practically. The success of the snake ladder game in meeting the needs of the youngsters under study for increased knowledge and improved practices can be explained, according to the researchers, by the gamification method. Insulin is frequently used in the management of type 1 diabetes mellitus. However, insufficient knowledge and malpractice on insulin self-administration could result in poor disease prognosis and insulin-related complications (Nasir et al., 2021). A cross-sectional study on insulin injection practices, attitudes, and knowledge was conducted in Egypt by Arif et al. (2023) the study identifies practice weaknesses among patients, which can be addressed to enhance their practices and improve diabetes care.

The results of the current study demonstrated that almost all of the type 1 diabetic children studied had competent levels of reported practice with insulin self-injection when the snake ladder game was used as a post-gamification strategy, while the majority had incompetent levels in the pretest. As per the researchers, most of the studied youngsters were of school age, and Erikson postulated that this particular period was marked by the confrontation between "Industry versus Inferiority." Children at this age are greatly impacted by their peers and teachers as they learn to master new abilities and responsibilities. When this stage is resolved successfully, kids feel competent and are most creative when playing puzzle games and trying to solve them sequentially. According to Pudjaningrum's (2019) research, health education through triggering can significantly influence the rise in practices. The Snakes and Ladders game is a health-teaching tool that includes facts and messages. It is bolstered by an assortment of captivating visuals that fit the given topics. Pre- and post-test results showed a greater increase in knowledge for the experiment group that played with snakes and ladders. Furthermore, According to a study by Pratiwi (2019), which supported these findings, the game improved students' environmental health practices and changed test results after it was introduced, suggesting that it might provide a fun and interesting setting for players.

The researchers claim that this game is more suited for presentations since it is simpler to play and store in both big and small groups. The use of suitable instructional media could help achieve the objectives of health education. Through playing the game, the children have to practice using their five senses: touch, hearing, sight, and snakes and ladders. They used their sense of vision to study a few of the images on it. They also read the language on the cards and touched the pawn from each box on the board. Similarly, Labibah (2019) found that the student's oral and dental health practices were significantly impacted by the game's modification. Those in the research who had previously expressed pessimism changed after learning about dental and oral health. In addition, several studies by Devi, 2019; Hani et al., 2020; Miki et al., 2020; Ridwan et al., 2022; Deol & Kodil et al., 2021); and others discovered that gamification is a suitable approach to use with the snake and ladders game for kids. Additionally, Saraswathy (2019) found in another study that the interventional group's awareness of dental hygiene differed significantly before and after the snake and ladder game. Another study by Kutwal et al. (2018) evaluated the impact of the snake and ladder game on knowledge of a balanced diet and found that the interventional group's mean score for knowledge before and after the intervention differed significantly.

Conclusion

The current study's findings led to the conclusion that using the snake ladder game to apply the gamification method improved children's knowledge and practices related to insulin self-injection.

Recommendations

Based on the findings of the current study the following recommendations are suggested:

- The implementation of gamification in the snakes and ladders game is suggested as an early learning tool for children to enhance appeal, engagement, and comprehension.
- The current study has to be repeated with a larger sample of new children in different circumstances in order to generalize the results.

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