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Conceptualizing the 'All You Can Eat' game to promote healthy eating habits among young children

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ABSTRACT

Childhood obesity is a growing concern globally, with unhealthy eating habits being one of the leading causes. In response, researchers and game designers have investigated the use of serious games to encourage healthy eating among young children. Creating successful serious games to encourage children's good eating habits involves thoughtful consideration of elements such as age-appropriate content, game mechanics, and motivator strategies. The aim of this project is to create a serious game design that promotes and supports healthy eating habits in youngsters. This study evaluates children's existing understanding of nutrition by gathering their comments using a serious game as an example. Various gaming elements are recognized, leading to the creation of a board game named "All You Can Eat" (AYCE). The design evaluation process involves conducting questionnaire surveys and gathering feedback from both parents and children. The results will assist future research in creating and bringing to realisation the AYCE game. This research can be extended to a range of health topics beyond healthy eating habits, such as serious games for learning about cultures and ethics. Researchers, educators, and game designers collaborate to produce unique and interesting games aimed at promoting good eating habits and preventing youngsters' obesity.

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1. INTRODUCTION

Childhood obesity has become a growing global concern in recent years. A healthy diet is essential for children's health, growth, and development, as they will be less likely to develop chronic diseases such as heart disease, diabetes, and obesity. According to the World Health Organisation (WHO), childhood obesity is one of the world's most serious public health issues in the 21st century. It affects every country in the world, especially during the COVID-19 pandemic, when children have fewer opportunities to be outside, and thus, fewer activities can be conducted. Obesity, however, can be prevented. Globally, the prevalence of childhood and adolescent overweight and obesity is rising. Primary school students, in particular, are associated with a significant increase in the prevalence of overweight and obesity [1]. Establishing a healthy lifestyle, encouraging outdoor activities, and providing nutritional education are all part of obesity prevention and intervention programmes to address the health challenges [2], [3]. The prevalence of childhood obesity can also be influenced by the way their environment revolves around them, including their parents' lifestyle,

school education, and friends, as well as the community surrounding them. Youngsters can get nutrition education, physical education, and awareness at an early age through school programmes, while parents can also contribute by incorporating these lessons into daily life.

Early nutritional education is crucial for influencing children's attitudes towards good eating [2], [4]. At this time of life, it is crucial for children's development. Furthermore, aside from dietary changes, additional effective intervention programmes will probably be necessary to enhance behaviour. After receiving nutritional education, an intervention programme will aid in further developing the children's understanding so they are able to practice what they consume. This is due to the fact that the intervention plan will place more emphasis on conduct and action than merely information, making it more beneficial to the learning environment for children [2], [4]. Nutrition includes information about food ingredients, the consequences of eating poorly, and suggestions for healthy eating habits. Teaching this knowledge to young people to tackle childhood obesity prevention and treatment is difficult. This is because youngsters may perceive it as monotonous and uninteresting, leading to a lack of interest in learning about nutrition. This has encouraged academics and game developers to consider creative concepts for encouraging children to eat well. One such strategy is the use of educational games that encourage youngsters to learn about healthy eating practices through engaging gameplay.

Utilising boardgame to encourage positive social behaviour among children suggest a postitive implementation [5], [6]. Similarly when this type of serious game implemented for good eating habits in youngsters. It can effectively facilitate positive behaviour change [7]. It may make the process of learning about healthy eating enjoyable and captivating for youngsters, enabling them to grasp nutritional concepts in an educational and amusing way [8]. Furthermore, serious games are expected to assist children in cultivating healthy eating habits that may endure for their lifetime [7], [9]. For example, a serious game like Pokémon Smile is widely used to promote the habit of brushing teeth in an enjoyable manner. Also, the game Coco's Cove educates people with type 2 diabetes about the impact of sugar and food consumption on a monkey's behaviour and health. Thus, serious games are increasingly being utilised as effective tools in healthcare for instructional and entertainment purposes.

Games can be developed for various platforms. Board games and digital games are the primary game classifications [10], [11]. New platforms are released more regularly as technology advances at a faster pace. As new technology is implemented, the distinctions between conventional platforms are becoming less apparent [11]. Online versions of board games have become more popular in recent years [12], [13]. Websites such as board game arena (BGA), for example, provide one of the largest online platforms that allow players from all over the world to play board games without the need to be physically present. Digital games are also known as video games and virtual games and can include cross-reality elements like virtual reality (VR), augmented reality (AR), and mixed reality (MR) [14]. Virtual games can take the player deep into the game world, allowing them to achieve total immersion [15]. Digital board games have been extensively researched in order to offer youngsters and healthcare professionals practical solutions for promoting knowledge and awareness of healthy eating habits. For example, research by Kato-Lin *et al.* [16] describes a randomised controlled trial that examined the effectiveness of a digital board game in promoting healthy food choices among children. Children who played the digital board game had greater knowledge of healthy foods and made healthier food choices than those who did not play the game, according to the authors. Another review by Bayeck [17] demonstrates that board games are appropriate methods for simplifying complicated problems and systems. Its application in healthcare will help the particular process get the results it needs.

Extensive research has demonstrated the value of digital board games as practical tools for promoting healthy eating habits among young people and supporting healthcare professionals in their educational efforts. For instance, a randomized controlled trial conducted by Kato-Lin *et al.* [16] intended to find the impact of pediatric mobile game play on healthy eating had found that children who engaged with a digital board game displayed a significantly improved understanding of healthy foods and made more informed food choices compared to those who did not participate in the game. This suggests that digital board games can effectively enhance nutritional knowledge and influence positive behavioral changes in children. Meanwhile, study by Chaisriya *et al.* [18] related to digital game for cultural food preservation in Thailand shows that digital games significantly can increase individual interest to learn cultural food. Even so, there still opinions on less of interest to digital game and relunctance in using games for food knowldge and cultural in Thailand.

Despite of the benefits of digital game, there are potential limitations to consider. Digital board games may not fully address the complexities of individual dietary habits and lifestyle choices, which are influenced by a variety of social, economic, and environmental factors [19]. Additionally, excessive screen time, even in the context of educational games, could lead to unintended negative consequences, such as reduced physical activity [20]. As Bayeck [17] highlights, while board games can simplify complex concepts,

it may also risk oversimplifying important health messages, potentially leading to misunderstandings or superficial engagement with the material. Thus, it is important to acknowledge that further research is necessary to fully understand the possibilities of digital board games usage in healthcare. They can be a valuable tool for enhancing learning and engagement.

This paper describes the process of creating a digital board game to educate children about the importance of consuming nutritious foods. This study proposes a digital board game design that educates parents on the significance of providing their children with healthy meals. The techniques adopted from game design thinking which included empathy, ideation, prototyping, and testing. The test the game idea, researcher engage with parents and their children to collect feedback via questionnaires and interviews based on the develop game design prototype. The design created for the board game in this study is intended to improve healthy eating awareness among youngsters and their parents. The paper is organised with an introduction detailing the research effort, followed by a summary of the methodologies and resources used in the study. The materials and methods section covers serious game exploration methodologies and game design creation procedures. The next section includes the presentation and discussion of the results. Finally, the concluding remarks as well as recommendations for future work are presented in the last section.

2. METHOD

This section explain in detail the approach and materials that were used to conceptualise and develop the board game. The methodology employed a series of phases that enabled the researcher to adopt a methodical approach in order to achieve the objectives of this study. This approach in this study guided by game design thinking-a human-centered approach that emphasizes empathy, ideation, prototyping, and iterative testing to develop solutions that are both effective and engaging [21], [22]. Game design thinking involves understanding the needs and motivations of the players, which in this case are children and their parents based on the preliminary design concepts adopted from existing nutrition intake approach. The design transform traditional ways to gameplay that not only entertain but also educate. The approach explain in two parts: i) promoting awareness of healthy eating among parents and children in subsection 2.1 and ii) the game concept and design in subsection 2.2 as well as gameplay in subsection 2.3. The game design thinking applied in the ideation process whereby the initial design of the game was prototyped and used to gauge parents and children opinion of its suitability. The process presented in Figure 1. This method ensured that the game effectively engaged players and conveyed the intended educational messages about healthy eating.

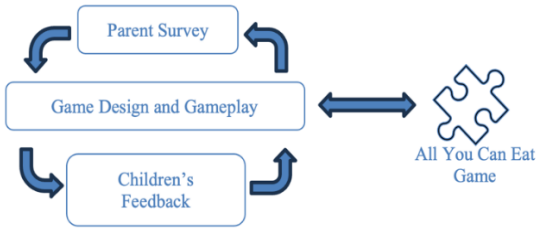

Figure 1. Parent and children input to game design process

2.1. Promoting awareness of healthy eating among parents and children

The awareness study was initially carried out in this research. This study aimed to provide an overview of the current impact of serious games on children's concept of healthy eating, as well as the role of parents in this context. Two empirical investigations were conducted: a survey for parents and children. The scope of involvement of parents and children (referred to as young children in this study) are details in the next subsection.

2.1.1. The research approach

This research included two studies: a survey questionnaire for parents (input) and a survey questionnaire for children (feedback). Both employed an online questionnaire approach, allowing for a larger number of participants from various cities in Taiwan.

a. Parents survey questionnaire

– Purpose: this study aims to gather information from a broad sample of parents regarding their perceptions of their children's understanding of a healthy diet and nutrition.
– Method: the respondents were parents of Taiwanese elementary school pupils. The survey questions were written to discover the primary school students' knowledge of healthy diets and nutrition.

- Procedure: there were three stages of this investigation. The parents of elementary school kids were initially invited to take part. The participants were made aware of the second stage's objective and gave their consent. Online survey forms are filled out in the third stage. Based on what they have observed about their children, parents will respond to the questionnaire.

b. Children's feedback

- Purpose: in order to get direct, in-depth comments about how to include education and fun into games, this research sought to get opinions from primary school kids about the game demo (presented through a video).
- Method: in order to receive feedback from the user side, the respondents were primary school students.
- Procedure: the participants were asked to watch a video for three minutes of the game being played and then complete the respective online questionnaire.

2.1.2. Survey questionnaire design

The survey questions were primarily designed to gather the necessary data for the purpose of this study. The survey questions were separated into two portions for this purpose i) inquiries for parents and ii) queries for children. The parent survey questioned about the parents' opinions, attitudes, perceptions, and viewpoints on serious games for kids promoting healthy meals, as well as their children's knowledge, and daily dietary habits. User research was used into the survey questions to develop a serious game for youngsters. The details of each section are as follows:

a. Survey questionnaire design for parents

The questionnaire was developed by monitoring the eating habits of participants in a food-education programme, in light of previous research by Nicodemo *et al.* [23] on childhood obesity and COVID-19 lockdowns. It was in response to the research conducted by Pujia *et al.* [24] on how COVID-19 affected the dietary habits of young individuals in Italy. These studies are solely concentrated on home cuisine, which differs from Asian cuisine. A study by Kurniawan *et al.* [25] examined childhood obesity and eating habits in Taiwan in 2020, while the children's organisation did a study on children's eating habits in Taiwan in 2015 [26]. The investigations were conducted locally with the customisation of the questionnaire accordingly.

The questionnaire survey of this study targeted Taiwanese parents with children between the ages of six and twelve who attend primary school. The survey aimed to investigate children's understanding of a balanced diet and nutrition, and to determine parental attitudes towards educational games. The survey questionnaire contained three categories: "children's eating habits," "parents' knowledge of food and nutrition among their kids," and "educational games". The initial category was created to examine the dietary habits of their children. The study asked parents if their children consistently consume three meals daily or maintain a balanced diet. The second category focused on evaluating the parents' involvement in educating their children and the children's comprehension of diet and nutrition. In the third category, the goal was to determine the parents' level of acceptance of serious games and their readiness to permit their children to use the game for learning about healthy eating.

b. Survey design feedback for young children

The survey questionnaire for young children, a user research design aimed at elementary school pupils. Children had to watch a three-minute video outlining the basic rules and concept of the board game before taking part in the study. The children were asked twelve questions about the board game, including whether they understood the rules. The questions aimed to determine the children's comprehension of diet and nutrition, as well as their receptiveness to learning through games. This research required the children's comments to improve their learning experience through games. The questionnaire was created for youngsters using concise language to avoid any misinterpretation of the questions. Moreover, during the assignment, the children may communicate with their parents, who could guide them to the survey. The questions were created and customised based on the 2021 serious games investigate survey [27], [28]. The questions were categorised into four groups: i) game interest; ii) game difficulty; iii) nutrition education and dietary behaviour change through games; and iv) serious game components.

2.2. The game concept and design

The "My Plate" initiative was established by the National Health Administration of the Ministry of Health and Welfare to advocate for a nutritious diet. This campaign raises awareness among individuals about the advantages of consuming nutritious food. "My Plate" illustrates a balanced diet by including a proportionate amount of food in each meal. Each dish should consist of equal portions of vegetables, protein, grains, fruits, and a side of dairy. The quarter-quarter notion inspired the authors to create a board game that translates food intake into a routine on a daily basis. The concept involves demonstrating how food intake and digestion may be modified in a simulation to help young individuals better comprehend the process.

The "All You Can Eat" (AYCE) nutrition game application was created following the "My Plate" concept. The term "plate" is used to represent a well-balanced dinner. The AYCE game features six unique nutritional aspects, each corresponding to one of the six food groups: i) whole grains; ii) oils, fats, nuts, and seeds; iii) legumes, fish, eggs, meat, and their products; iv) dairy; v) vegetables; and vi) fruits. The game will assist players understand different food categories, and how they may be combined to create a nutritious meal, promoting healthy eating habits. We conceptualised the "My Plate" for our AYCE board game by designing the plate concepts into three panels of cards: i) cuisine card and meal selections on the right side; ii) bonus card in the upper left side; and iii) tokens in the lower left side. Figure 2 depicts the design of the board game. There are 95 cuisine cards available for selection. We developed 36 cuisine cards for breakfast, 31 for lunch, and 28 for dinner out of a total of 95 cards. The number of cards was determined based on the typical meal found in general cuisine. The bonus cards provide unique abilities that enable players to advance and enhance their enjoyment of the game. Players must add tokens representing different types of food at the beginning to select their cuisine card.

Figure 2. All you eat boardgame design

2.3. The game play

The game may accommodate up to four players. They must determine the order in which each player will take their turn. Every player goes in a clockwise direction. During a player's turn, they must choose and execute one of the three acts indicated:

- Choose a maximum of three cuisine cards in the sequence of breakfast, lunch, and dinner. Place the correct tokens on your plate board. Players cannot take a cuisine card if the token beyond the limit on the plate board.
- Select a maximum of 7 tokens from the player's board, regardless of their hue.
- Eliminate the 14 tokens that meet the requirements of the balanced diet formula. Receive an additional bonus card. For a single-use bonus card, make sure to utilise it immediately.

The game ends in one of the following manners: after a player successfully completes the balanced diet formula three times, one of the cuisine card decks becomes depleted. The player calculates their score by summing the numbers on the cuisine cards. Every token remaining on the plate board decreases the score by one. The winner is the player with the highest score. When both players have an equal score, they are considered to have tied.

3. RESULTS

The survey findings are given in two sections, one for parents and one for children. The initial component of the study included an analysis of the participants' demographics, such as gender distribution and body mass index (BMI). The statistical analysis, which includes the mean and standard deviation (SD), is presented in the second section.

3.1. The parents' survey questionnaire

3.1.1. Demographic information

A total of 62 parents of children participated in the survey. No siblings were present among the children. Thus, a total of 62 children took part in the survey. Table 1 shows an equal distribution of genders among the youngsters, with 50% boys and 50% girls. Within the sample, 33.9% of participants were in grades 1-2 (N=21), 41.9% were in grades 3-4 (N=26), and 24.2% were in grades 5-6 (N=15) (refer to

Figure 3). Figure 4 shows the percentage of participant's BMI. 64.5% of the children had a normal BMI, whereas 21.0% were underweight, 9.7% were overweight, and 4.8% were obese.

Table 1. Participant's gender demographic

Gender	Number of participants (N)	Percentage (%)
Boy	31	50
Girl	31	50

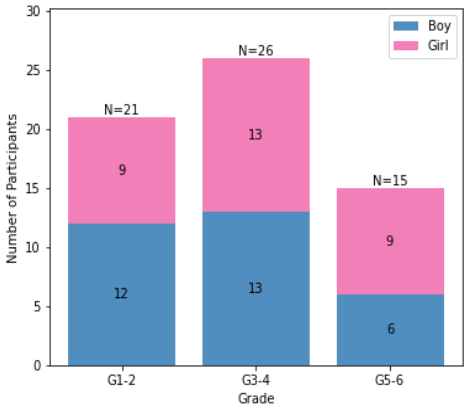

Figure 3. Participants' grade and gender

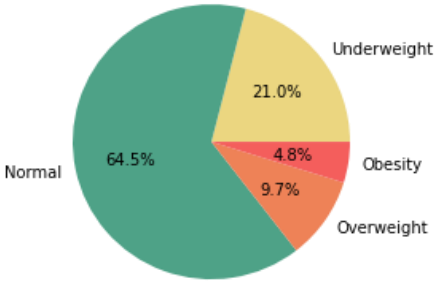

Figure 4. Participants' BMI

3.1.2. Survey's statistical analysis

A reliability analysis was conducted to assess internal consistency of individual questions within a component as well as the entire set of questions. The Cronbach's alpha coefficients in Table 2 indicate that the 22 items in the questionnaire had satisfactory reliability values (σ=.73). From the parent's survey, the result is divided into three sections namely, i) habit refers to children's dietary habits; ii) knowledge refers to diet and nutrition knowledge among their children; and iii) game refers to educational games. The children's dietary habits section of the survey sought to ascertain the role of parental influence on children's dietary habits. There were six questions in this section divided into three sections; these included the children's basic diet, eating behaviour, and vegetable intake. Parents' roles in the education section are to be ascertained by asking their children questions about nutrition and diet as well as their own understanding of these topics. The purpose of the educational game session is to determine the level of parental approval towards instructional games promoting a healthy diet. Table 3 displays the mean and SD for each item. Most questions received excellent comments from parents, except for knowledge related question: i) taking the child to a food factory to learn how food is manufactured and ii) letting the child observe the nutritional value and ingredients of food packages while shopping. The mean for these two questions showed that most of the parents were disagreed with the statement.

Table 2. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on standardized items	N of items
.73	.77	22

3.2. Children's feedback survey

3.2.1. Demographic information

A total of 30 primary school-aged volunteers were recruited for this experiment. Among the participant, 46.7% were girls and 53.3% were boys. Participants were divided into three groups based on their grade levels: group 1 (students who are in grade 1-2), group 2 (students who are in grade 3-4), and group 3 (students who are in grade 5-6). There were eleven kids in group 1, with six boys and five girls, and eight students were in group 2 (six boys and two girls). There are a total of eleven pupils in group 3, consisting of four boys and seven girls. Figure 5 displays the dispersion of these students group. In Figure 6, the children's BMI indicates that 70% of the participants have a normal weight, 20% are underweight, and 10% are overweight, with none being classified as obese.

Table 3. Item's mean and SD, N=62

Itemised questions	Mean	SD
Habit		
I think my child has a balanced diet	3.39	1.01
I think my child is a picky eater	3.30	1.16
I think my child has a regular diet for 3 meals a day	4.02	0.95
I think my child won't overeating	3.91	1.10
I think my child has sufficient vegetables for everyday	3.15	0.99
I need to spend a lot of effort to encourage my child to eat vegetables	3.15	1.35
Knowledge		
I will bring my child to buy ingredients for the food	4.26	0.81
I will teach my child the importance of balanced diet	3.01	1.20
I will teach my child to recognize different food ingredients	3.52	1.24
I will teach my child the nutritive value of different food	3.66	1.01
I think my child does not have the knowledge of nutritive value in food	3.06	1.20
I will take my child to a food factory to learn how the food is made	2.35	1.11
I will let my child cook with his/her family together	3.08	1.34
I will let my child notice the nutritive value and ingredients of the food package while shopping	2.55	1.25
My child only picks the food he/she likes and doesn't care about nutritive value and ingredients	3.29	1.37
Game		
I support combining learning with game	4.60	0.73
I don't think educational game will improve children's dietary habit	4.51	0.78
I don't support learning through game	4.52	0.78
I am willing to let my child learn knowledge through game	4.56	0.66
Can learning through games reinforce my child learning process	4.35	0.87
I think educational game will help children to get a better understanding of balanced diet	4.10	0.95
I think educational game will improve children's dietary habit	3.89	1.12

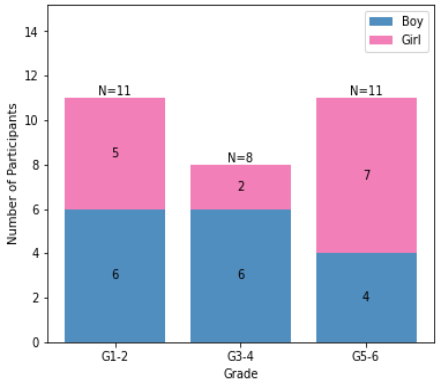

Figure 5. Participants' grade and gender

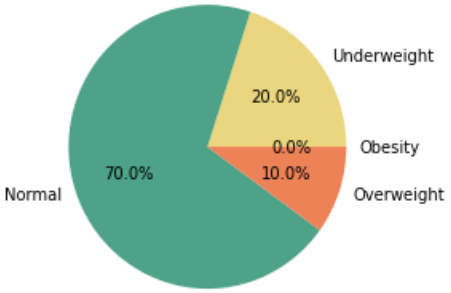

Figure 6. Participant's BMI

3.2.2. Children survey statistical analysis

The Cronbach's alpha coefficients in Table 4 shows that the 12 items in the question achieved satisfactory reliability values (σ=.87). Table 5 displays the mean and SD for each question in the children's survey. All items received favourable input from the children, indicating unanimous agreement with all the questions.

Next is the normality test. The result of normality test is presented in Table 6. The result of all items has suggested a normal distribution. All items related to children's game acceptance, $D(30)=.122$, $p>.05$, was normal, indicating that data was normally distributed. Thus, parametric test will be used to derive the findings from this survey. One sample t-test was carried out to test if there is a significant difference between the mean score for each item from the agreement value (5 and 4) to disagreement value (2 and 1) using the neutral value, which is 3. The results in Table 7 shows that the student's agreement on the game's acceptance have a higher mean than the test value.

The discussion focused on children's interest in games, the game's difficulty level, games for nutritional education and behaviour control, and the components of serious games. The sessions yielded great results. The game has pleased the young person.

Table 4. Reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on standardized items	N of items
.87	.83	12

Table 5. Item's mean and SD, N=30

Itemised questions	Mean	SD
Q1. I don't want to introduce this game to my friend	3.83	0.95
Q2. I want to invite my friend to play this game	3.77	1.16
Q3. I'm interested in this game	3.77	1.35
Q4. I can understand this game easily	3.40	1.13
Q5. I think this game will help me understand healthy diet better	3.83	1.05
Q6. I think this game will make my dietary habit healthier	3.96	0.93
Q7. I think this game will let me become more willing to try food that I don't like	3.17	1.02
Q8. I think this game will make me more aware of the nutrition facts and ingredients of food	3.93	1.11
Q9. Can learning though these games reinforce my learning process	3.93	1.01
Q10. I think foods from different countries in this game will make me more interested in this game	4.23	0.82
Q11. I think this game will help me to learn cuisine culture in different countries	4.10	0.99

Table 6. Test of normality

Item	Kolmogorov-smirnova			Shapiro-wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Games acceptance	.122	30	.200*	.946	30	.130

[a.] Lilliefors significance correction
* This is a lower bound of the true significance

Table 7. One sample t-test

Items	Test value=3				
	t	df	Mean diff.	95% confidence interval of the difference	
				Lower	Upper
Q1	10.57	29	<.001	1.48	2.18
Q2	8.31	29	<.001	1.33	2.20
Q3	7.13	29	<.001	1.26	2.27
Q4	6.77	29	<.001	.98	1.82
Q5	9.53	29	<.001	1.44	2.22
Q6	11.61	29	<.001	1.62	2.31
Q7	6.26	29	<.001	.79	1.55
Q8	9.52	29	<.001	1.52	2.35
Q9	10.43	29	<.001	1.55	2.31
Q10	14.97	29	<.001	1.93	2.54
Q11	11.56	29	<.001	1.72	2.47

4. DISCUSSION

The discussion has been divided into two sections based on the two distinct types of survey activities performed in this study. The first portion presents the findings of the parent's questionnaire, while the second section examines the findings of the children's questionnaire.

4.1. Parents survey findings

Most children were in either lower classes (1-2) or middle grades (3–4), based on the findings we observed. Therefore, the parents will be responsible for providing most of the children's eating habits. We examined the children's eating patterns, their perception of food and nutrition, and the parents' attitudes towards utilising educational games to educate children about nutrition. The discussion proceeded as:

a. Children's dietary habit

Parents' dietary habits have influenced their children's dietary patterns. Understanding their children's eating behaviours is crucial for parents. Most parents, as per the survey, perceive that their children have a healthy diet, although they also consider them to be picky eaters. Parents believe that their children consume a sufficient quantity of vegetables daily. They must exert a significant amount of effort to encourage their children to consume vegetables. The goal of the game is to encourage children to independently select healthy foods.

b. Children's knowledge of diet and nutrition

Education regarding diet and nutrition in schools is not limited to children. Family education is very crucial, especially for children under the age of five. Parents often emphasise the significance of consuming a nutritious and balanced diet for their children. However, they don't take their kids grocery shopping on a regular basis. Culture may have an impact on it. Dual-career families are prevalent in Taiwanese society. Their parents are too preoccupied to prepare meals or purchase groceries. They often ordered takeout or dined at restaurants. They educate their children on the nutritional benefits of different meals and teach them to identify various food components. However, few parents believe that their children are unaware of the nutritional

benefits of food. The survey also found that a small number of parents would bring their children to an agricultural facility to demonstrate the food production process. It is uncommon for parents to allow their children to examine the ingredients and nutritional details on food packaging while shopping. Parents often believe that their child chooses foods based on taste preferences rather than considering the nutritional value or components of the dish. In addition, street food and eateries in Taiwan are currently rather reasonably priced. Cooking becomes impractical when managing a hectic family schedule. Parents try to instill in their children the importance of eating a healthy diet. Nevertheless, doing so in practice presents a formidable obstacle.

c. Educational game

The instructional game is becoming increasingly popular. Most parents are in favor of integrating education into gaming. Moreover, they are willing to allow their children to experience it. They believe that children can better understand a balanced diet through educational games, which are a form of reinforcement learning. Conversely, a small number of parents believe that educational games do not positively impact their children's dietary habits. It may be related to the urban-rural divide.

Most elementary schools are now promoting the use of serious games, which combine instruction with play for learning purposes. Some schools may not have the required technology to support them. Consequently, they lack an understanding of how instructive games work. Some parents feel uneasy about their children playing video games due to concerns about potential gaming addiction. There are educational video games that have reasonable screen usage limits, which have similar concerned raise by [20], and this should be taken into consideration in desigining and implementation of the game.

4.2. Children feedback findings

This study involved thirty students. They are at various educational levels. This condition could affect the outcome. Thirty percent of the students are in grades 1-2. They may struggle to comprehend the game and the questions. However, step-by-step instructions with the researcher's assistance could lessen the outcome's bias. The subsequent discourse will be delivered in the following manner: it is predicated on concerns raised in the survey that we wish to investigate further.

a. Interest in game

After viewing the video, the majority of students were intrigued by this activity. Likewise, some students might feel uncertain about their level of interest. Playing the game offers a distinct experience compared to simply watching a video of it. Most students like playing this game with their friends.

b. The difficulty of the game

Identifying the degree of difficulty of the game for various primary school grade levels presents a challenge. Students may find this game straightforward and not excessively challenging. However, a significant number of students also contend that comprehending the game completely is tough. We assumed that their understanding of the game could be rudimentary, as they only viewed the initial three minutes of the video and have not yet engaged in playing the game extensively.

c. Nutrition education and dietary behaviour change game

The main focus of the theoretical game is behaviour modification and instruction. Prior to modifying their behaviour, individuals must acquire the necessary knowledge. Most students, as indicated by the survey results, think that this game would improve their dietary habits, and provide them with a deeper insight into nutritious meals. Students are more knowledgeable about nutrition facts and food substances. As a result, they are more inclined to try foods they dislike.

d. The components of serious games

Game-based learning is a form of reinforcement-based learning. A game is an entertaining activity. Therefore, there's no point in playing a serious game if it's not entertaining. Most students believe that games may serve as immersive learning platforms that enhance their learning efficiency. Players can explore various cuisines throughout the world in the game AYCE. The game AYCE plays a significant role in promoting a healthy diet. Consequently, most students begin to display a heightened interest in the game, which will also enhance their knowledge of international food and culture.

The findings of this study highlight the potential of digital board games to effectively promote healthy eating habits among children, similar with suggestion from previous work such as in [16]-[18]. Through a combination of engaging game mechanics and educational content, the AYCE game demonstrates the value of serious games in encouraging healthier dietary choices. These insights provide a foundation for further research and practical applications in health education. However, several limitations must be acknowledged. First, the study relied on a small sample size, which may not fully represent the diverse demographic and socioeconomic backgrounds of children and their families. Second, the conducted study only limit for a short-term evaluation. It limits the ability to evaluate the long-term impact of the game on behavior change. Future research should address these limitations by involving larger, more diverse populations and conducting longitudinal studies to assess the sustained effectiveness of such interventions. Moreover, integrating digital games with real-world health initiatives could offer a more comprehensive solution to childhood obesity and nutrition education.

5. CONCLUSION

This project aims to establish an emerging field of research in the intersection of gaming and health informatics, with a specific focus on promoting positive health outcomes for young children. The study examines the use of digital platforms, such as games, to actively include young children in learning about a nutritious diet. By including games into the application, children will be more inclined to remain engaged until the completion of the activity. Consequently, the process of learning through play will have long-term advantages for them. Games have the ability to improve self-control and involvement, as well as induce changes in conduct. The study will facilitate other researchers in the discipline in acquiring a more profound comprehension of the requisites of young individuals. The AYCE game represents a promising approach to addressing childhood obesity by promoting healthy eating habits through an engaging and educational platform. This study underscores the importance of integrating age appropriate content, game mechanics, and motivational strategies to create a successful serious game that resonates with young children. By evaluating children's current understanding of nutrition and incorporating feedback from both parents and children, the game design aims to be both effective and appealing. The insights gained from this research will contribute to the development of future serious games focused on health education, with potential applications extending beyond nutrition to include broader topics such as cultural understanding and ethics. Collaboration among researchers, educators, and game designers is essential in the ongoing effort to create impactful tools for fostering healthy lifestyles in children. The future work of this study will involve publishing the game that was produced based on the finalised concept. After being published, an acceptance user study will be undertaken with young children to verify the game's applicability and its potential benefits in a real environment.

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