



The Effects of the V-Card Program on Healthy Food Consumption among School Children in Thailand

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Abstract

Background: Childhood obesity represents a significant and escalating public health challenge worldwide, with a particularly profound and sustained impact on low- and middle-income countries, especially in urban areas ⁽¹⁾. The rising prevalence of overweight and obesity among children leads to a cascade of adverse physical and psychological consequences. **Objective:** This quasi-experimental study aims to evaluate the effectiveness of the V-Card Program, developed based on self-regulation theory, in promoting healthy food consumption behaviors among Grade 5 students in Chanthaburi Province, Thailand. **Methods:** Thirty-five students in the intervention group participated in five intervention activities under the V Card intervention, while 35 students in the comparison group continued with the standard school curriculum. Data were collected on nutritional knowledge, attitudes, and food consumption behaviors, using a pretest-posttest design. **Results:** The results showed that, the post-intervention scores in the experimental group were significantly higher than those in the comparison group. ($p < 0.001$). **Conclusion:** The findings indicate that the V Card Program is an effective and feasible approach for improving nutritional knowledge, attitudes, and healthy dietary behaviors in the short term. Therefore, it is recommended that schools and public health authorities scale up the implementation of this program. Additionally, policymakers should consider integrating interactive, learner-centered tools such as the V Card and board games into national curricula to promote long-term and sustainable health behavior change from early childhood.

Keywords: Game-based learning, School children, Self-regulation theory, Nutrition education, Healthy food consumption.

What was Known

- School children often have poor nutrition knowledge and unhealthy food consumption.
- School nutrition education improves knowledge but behavior change remains limited.
- The V Card Program can strengthen motivation and engagement in nutrition education.

What's New and Next

- A self-regulation card game improved nutrition knowledge and healthy eating behavior.
- The program significantly improved attitudes and food consumption among school children.
- The V Card Program can serve as a nutritional education tool to support sustainable healthy food consumption in schools.

Introduction

Physically, excess weight in childhood is associated with a wide range of health problems affecting the musculoskeletal, cardiovascular, respiratory, gastrointestinal, endocrine, and metabolic systems⁽²⁾. Beyond its physical consequences, childhood obesity is associated with social stigmatization, reduced quality of life, and increased long-term healthcare expenditures⁽²⁾. Unhealthy food consumption has been recognized as one of the major modifiable determinants of childhood overweight and obesity. Dietary patterns characterized by excessive consumption of energy-dense foods, sugar-sweetened beverages, and processed snacks, together with insufficient intake of fruits and vegetables, contribute substantially to excessive weight gain and poor health outcomes among children^(3,4). Therefore, promoting healthy food consumption during childhood is considered a key strategy for preventing obesity and establishing lifelong healthy eating habits⁽⁵⁾. In Thailand, the prevalence of childhood overweight and obesity continues to increase. In 2023, 13.13% of school-aged children (6–14 years) were classified as overweight or obese, representing 591,485 children out of a total population of 4,504,440⁽⁶⁾. This marked a substantial increase from 10.11% in 2017. Consequently, national health indicators were revised to include a target of maintaining the prevalence of overweight and obesity among school-aged children at or below 10%⁽⁷⁾. This national trend is also evident in Chanthaburi Province. Within Health Region 6, Makhm District has experienced a particularly concerning increase in childhood overweight and obesity. The district's ranking among the province's ten districts rose from fourth in 2018 to third in 2020 and second in

2023^(8,9,10,11,12,13). This persistent upward trend highlights the urgent need for effective interventions that promote healthy food consumption and prevent obesity among school-aged children.

Healthy food consumption extends beyond actual food intake and encompasses the knowledge, attitudes, and behaviors that influence food choices and eating practices^(3,14). Improving children's nutrition knowledge, fostering positive attitudes toward healthy eating, and encouraging healthy dietary behaviors are essential components of sustainable obesity prevention efforts^(3,15). Schools provide an important setting for such interventions because they offer opportunities to reach children during a critical period of habit formation and behavioral development⁽¹⁶⁾. Previous research has demonstrated the effectiveness of theory-based interventions in promoting healthy eating and other health-related behaviors. Self-regulation programs have been shown to improve desirable behaviors among students⁽¹⁷⁾, while interventions based on Social Cognitive Theory have successfully modified snack consumption habits⁽¹⁸⁾. In addition, educational games have emerged as a promising approach for promoting healthy food consumption. Studies conducted in Thailand and internationally, including the "Kaledo" board game developed by Viggiano et al.⁽¹⁹⁾ and the "Rango Cards" game developed by Chagas et al.,⁽²⁰⁾ demonstrated that game-based interventions can improve nutrition knowledge, self-efficacy, eating behaviors, and, in some cases, reduce body mass index (BMI).

The Victory Card Program (V-Card Program) was therefore developed as an innovative board game-based nutrition education intervention to promote healthy food consumption among primary school students. The letter "V" represents Victory, symbolizing the achievement of positive health outcomes through appropriate food choices and healthy dietary practices⁽²¹⁾. The program integrates principles of Self-Regulation Theory and Game-Based Learning⁽²²⁾ to encourage active participation and foster sustainable behavior change. The V-Card Program was designed based on the three core components of Self-Regulation Theory: self-observation, self-judgment, and self-reaction. Students engaged in activities that required them to record their food consumption (self-observation), classify and evaluate the appropriateness of their dietary choices (self-judgment), and receive feedback, rewards, and reinforcement through interactive board game activities (self-reaction). Through participation in the V-Card board game, students actively learned about food groups, healthy food selection, and the consequences of dietary choices in a collaborative and interactive learning environment. In this study, healthy food consumption was conceptualized as a multidimensional construct comprising three interrelated domains: nutrition knowledge, attitudes toward healthy eating,

and healthy dietary behaviors⁽²³⁾. Accordingly, the effectiveness of the V-Card Program was evaluated by examining changes in these three domains. Therefore, this study aimed to investigate the effectiveness of the V-Card Program, a self-regulation–based board game intervention, in promoting healthy food consumption among Grade 5 students in Chanthaburi Province, Thailand. By facilitating self-observation, self-judgment, and self-reaction through engaging game-based activities⁽²⁴⁾. The findings may provide an effective, practical, and replicable model for promoting healthy food consumption and preventing childhood obesity in school settings.

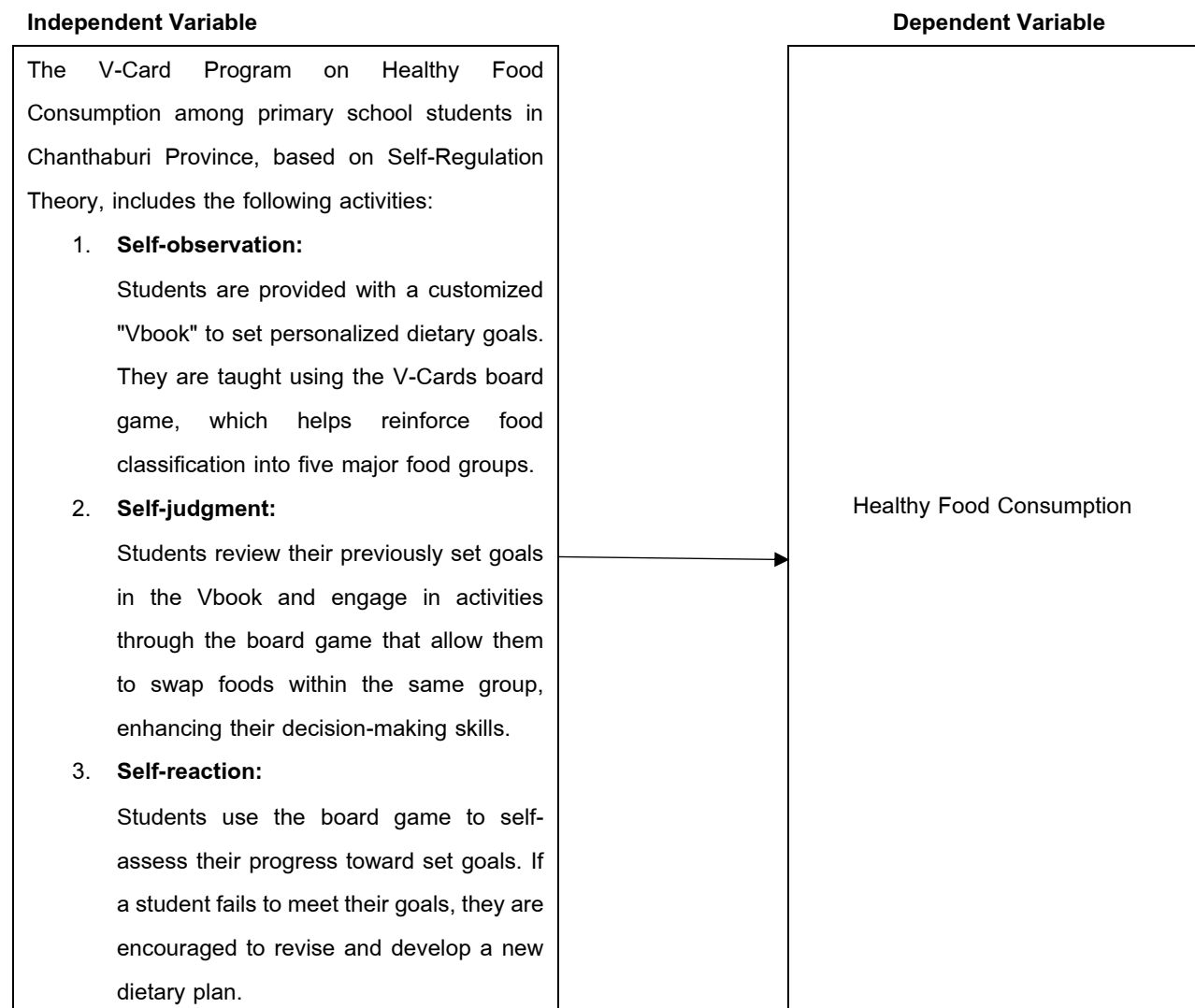


Figure 1 Study's Conceptual Framework

Materials and Methods

1. Research Design

This study utilized a quasi-experimental research design involving a two-Group Pretest – Posttest Design. Participants were divided into an experimental group and a Comparison group.

2. Population and Sample

The population consisted of both male and female Grade 5 students, enrolled in schools under the Office of Primary Educational Service Area, Chanthaburi Zone 2, Makham District, under the Office of the Basic Education Commission, during the academic year 2024. The sample size was determined using the formula for calculating sample size to compare the means of two independent groups ⁽¹⁶⁾. Using proportions from the study by Oranong Chookaew ⁽²⁵⁾. The calculation indicated a requirement of 33 students in each group. However, to account for potential dropouts and incomplete data during the experiment, the researcher increased the sample size 35 participants per group.

Inclusion Criteria: Students were late-primary school age (10-12 years old), and are studying in Grade 5 during the academic year 2024. Students voluntarily participate in the program, and their parent or guardians provide consent for their child's participation in the research.

Exclusion Criteria: Students who were unable to attend the scheduled activities.

Discontinuation Criteria: Participants who withdraws after enrolling in the study were discontinued from the research.

Selection of Experimental and Comparison groups as follows:

Schools were purposively selected from among 14 primary schools under the Office of Primary Educational Service Area, Chanthaburi Zone 2, Makham District, Chanthaburi Province. These selected schools were similar in size and had comparable teaching approaches. Two schools were randomly selected by drawing lots and were designated as the experimental and comparison schools. The first school was assigned to the experimental group. The second school was assigned to the comparison group.

3. The research instruments were divided into two parts:

3.1 Instruments Used in the Experiment.

The research instrument developed by the researcher was the V-Card Program, a board game-based nutrition intervention designed to promote healthy food consumption among primary

school students. Healthy food consumption was defined as comprising three dimensions: nutrition knowledge, attitudes toward healthy eating, and healthy dietary behaviors. The program was developed based on Self-Regulation Theory and incorporated game-based learning activities to enhance students' knowledge, attitudes, and behaviors regarding healthy food choices.

The program consisted of 5 activities over 3 weeks, with 2 hours per week (except for Week 2, which included three days at one hour per day), following as:

Week 1: What I Eat in a Day. Activity Objectives:

- 1) Students can classify the five main food groups.
- 2) Students can select appropriate foods for themselves.
- 3) Students can evaluate their own food consumption.

Week 2: How Much Rice? What Else Can I Eat? (3 Activities) Activity Objectives:

- 1) Evaluate one's own food consumption.
- 2) Correctly select foods from the rice and flour group according to type and quantity.
- 3) Correctly select foods from the fat and meat groups according to type and quantity.
- 4) Correctly select foods from the vegetable and fruit groups according to type and quantity.

Week 3: Market Trip: Delicious Finds not Missed. Activity Objectives:

- 1) Correctly classify food according to the five main food groups.
- 2) State the required food quantities for school-aged children.
- 3) Design a complete 5-food group meal plan for one day.
- 4) Evaluate one's own food consumption; select foods from the 5 food groups with correct types and quantities.

3.2 Data collection Instruments

The data collection instruments developed by the researcher were divided into four parts:

Part 1: General Information Questionnaire. This questionnaire consists of 5 multiple-choice and fill-in-the-blank questions, including item on sex, parental income, household cook, weight, and height

Part 2: Knowledge Questionnaire on Food and Nutrients. This questionnaire consists of 20 multiple-choice questions with four options each. It was adapted from the Teacher's Guide for Basic Science and Technology ⁽²⁶⁾. The criteria for knowledge levels were based on Bloom's taxonomy ⁽¹⁸⁾,

with knowledge categorized as follows: High knowledge: scores of 80% or above. Medium knowledge: scores between 60-79%. Low knowledge: Scores below 60%.

Part 3: Attitude Questionnaire on Food and Nutrients. This questionnaire consisted of 20 items measure using a five- point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree)

Part 4: Food and Nutrient Consumption Behavior Questionnaire. This questionnaire consisted of 20 items, including both positive and negative statements. It was designed to assess the quantity, frequency, and consistency of food consumption over the past week. The frequency Criteria were defined as follows: Always: Practiced 6-7 days per week. Never: not practiced at all during the week.

For positive items, practicing the behaviors 6 -7 days per week was scored as 4 points, while never practicing the behavior was score as 1 point. For negative items, the scoring was reversed: practicing the behaviors 6-7 per week was score as 1point, while never practicing the behavior was score as 4 points.

The questionnaire underwent content validity assessment by three experts. A try-out was conducted with 30 students who were similar to the sample group. The reliability of Sections 2– 4 of the questionnaires was analyzed using Cronbach's Alpha Coefficient, yielding values of 0.62, 0.61, and 0.60, respectively.

Although these values are considered moderate, they are deemed acceptable for research involving young children aged 10 years. At this developmental stage, children may have limited reading comprehension, shorter attention spans, and variability in cognitive processing, which can affect the consistency of their responses. In addition, their interpretations of questionnaire items may vary due to differences in language understanding and experiential background. These factors commonly result in lower internal consistency compared to studies involving adolescents or adults.

Results

The sample consisted of 35 students in the experimental group (16 males, 19 females) and 35 students in the comparison group (18 males, 17 females). Regarding nutritional status, the experimental group primarily comprised students with normal weight (63%), followed by students at risk of obesity (17%).

Similarly, the comparison group also mostly consisted of students with normal weight (66%), followed by those who were severely underweight (17%). Additionally, 2% of the students in the comparison group were found to be at risk of obesity.

The majority of students in the experimental group (69%) received a daily allowance of 0-50 Baht for school, while most students in the comparison group (66%) received the same amount. Furthermore, most parents or guardians in the experimental group prepared meals at home (80%); similarly, in the comparison group (94%), of parents or guardians also prepared meals at home (Table 1).

Table 1 General information of number and percentage of experimental and comparison groups

Characteristics	Experimental Group		Comparison Group		X ²	p-value
	Number	%	Number	%		
Gender						
Male	16	47	18	53	0.229	0.632
Female	19	53	17	47		
Nutritional status (Growth charts)						
Wasted	1	3	1	3	4.356	0.499
Underweight	2	6	6	17		
Normal Weight	22	63	23	66		
Overweight	2	6	1	3		
At Risk of Obesity	6	17	2	6		
Obese	2	6	2	6		
Daily Allowance						
Received at School						
0 - 50 Baht	24	69	23	66	0.065	0.799
51 - 100 Baht	11	31	12	34		
Home Cooking						
Cooks at Home	28	80	33	94	3.188	0.074
Food Outside	7	20	2	6		

Before the intervention, there were no statistically significant differences between the experimental and comparison groups in nutritional knowledge ($p=0.073$), attitude toward healthy eating ($p=0.262$), or dietary behavior scores ($p=0.965$), indicating that the two groups were comparable at baseline.

Following the intervention, the experimental group demonstrated significantly higher scores than the comparison group across all outcome measures. The mean nutritional knowledge score in the experimental group increased significantly more in the experimental group than in the comparison group ($p<0.001$). Similarly, the experimental group achieved a significantly higher attitude score than the comparison group ($p=0.002$). Dietary behavior scores were also significantly higher in the experimental group than in the comparison group after the intervention ($p=0.011$) (Table 2).

Table 2 Scores of nutritional knowledge, attitude, and dietary behavior in the experimental and comparison groups between pre- and post-intervention.

	Pre-intervention			Post-intervention		
	Experimental	Comparison	<i>p</i> -value	Experiment	Comparison	<i>p</i> -value
	group	group		al group	group	
	$\bar{x} \pm SD$	$\bar{x} \pm SD$		$\bar{x} \pm SD$	$\bar{x} \pm SD$	
Knowledge	8.23±2.67	7.00±2.97	0.073	12.43±2.03	6.57±2.78	$p<0.001^*$
Attitude	48.31±5.74	46.80±5.47	0.262	51.26±6.91	46.37±5.48	0.002*
Dietary behavior	54.43±5.08	54.37±5.82	0.965	55.83±5.07	52.20±6.39	0.011*

Discussion

The findings demonstrated that the V-Card Program was effective in promoting healthy food consumption among primary school students. Following the intervention, students in the experimental group achieved significantly higher scores across all three domains compared with those in the comparison group, indicating that the program successfully enhanced students' understanding, perceptions, and practices related to healthy food consumption (Table 2).

These findings suggest that the V-Card Program effectively promoted healthy food consumption through the integration of Self-Regulation Theory and Game-Based Learning. Game-based learning strategies allow students to actively participate in the learning process, thereby enhancing engagement, knowledge retention, and understanding. This finding is consistent with previous studies demonstrating the effectiveness of game-based learning in nutrition education. Research examining game-based activities among overweight upper primary school students aged 9–12 years⁽²⁷⁾ indicated improved knowledge regarding fruit and vegetable consumption, with an average post-intervention score of 8.5 out of 10. The study applied Dale's Cone of Learning⁽²⁸⁾.

Similarly, Wallapa Wassanasompong⁽²⁹⁾ developed a health education program using game-based learning to enhance nutritional knowledge among Grade 3 and 4 students in Samut Songkhram Province. The results showed that post-intervention knowledge scores were significantly higher in the experimental group than in the control group ($p<0.05$). These findings support the effectiveness of game-based learning approaches in improving nutrition-related knowledge, which constitutes an important component of healthy food consumption. Furthermore, Carolina Martins dos Santos Chagas et al. developed Rango Cards⁽³⁰⁾, a digital educational game based on the Brazilian Dietary Guidelines for secondary school students. The game used color-coded food cards representing different levels of food processing to simulate the health impacts of dietary choices. After three weeks of implementation, students reported increased nutritional awareness, greater engagement, and improved understanding of healthy food choices. Participants indicated that “playing the game helped them learn how to choose healthy foods”.

The present study demonstrated that the V-Card Program significantly enhanced students' attitudes toward healthy food consumption. These findings are consistent with research by Laohajatsang and Hanwong⁽³¹⁾, which highlighted the effectiveness of game-based learning in improving learning outcomes, attitudes, and learner engagement. Similarly, Laohajatsang and Kanchanakuha⁽³²⁾ reported that game-based learning fostered learner-centered experiences that improved attitudes, motivation, and active participation in learning activities. Positive attitudes toward healthy eating are important because they increase the likelihood that children will adopt and maintain healthy food consumption practices.

For healthy dietary behaviors, the findings suggest that behavioral change remains the most challenging component of healthy food consumption. Lally et al.⁽³³⁾ reported that, on average, approximately 66 days are required for a new behavior to become habitual, particularly dietary behaviors such as increasing fruit and vegetable intake or reducing sugar consumption. Michie et al.⁽³⁴⁾ emphasized that sustained behavior change requires a combination of knowledge acquisition, attitude development, self-monitoring, and ongoing reinforcement. Furthermore, Bandura's Social Cognitive Theory supports the importance of observation, reinforcement, and motivation in facilitating long-term dietary behavior change. This pattern suggests that the V-Card Program exerted a stronger influence on cognitive and affective components of healthy eating behaviors than on behavioral outcomes. According to Self-Regulation Theory, changes in knowledge and attitudes often precede observable changes in behavior because individuals must first develop awareness, understanding,

and positive evaluations before translating them into consistent actions⁽³⁵⁾. Therefore, improvements in nutrition knowledge and attitudes may occur more rapidly than changes in actual food consumption practices.

Although dietary behavior exhibited the smallest magnitude of change, the positive increase indicates that the intervention contributed to healthier food consumption practices among students. It should be noted that healthy food consumption behaviors in primary school children are influenced by factors beyond individual knowledge and attitudes. At this developmental stage, children have limited control over food selection because meals are largely determined by parents, caregivers, and school food services. Previous studies have shown that parental feeding practices, food availability at home, family eating patterns, and parental role modeling are important determinants of children's eating behaviors^(36,37). Consequently, even when children acquire nutrition knowledge and develop positive attitudes toward healthy eating, their opportunities to practice healthy dietary behaviors may still be limited by home and school food environments. Nevertheless, behavioral change does not occur uniformly across individuals. Barriers such as reduced motivation, environmental influences, and peer pressure can hinder the adoption of healthier dietary habits⁽³⁸⁾. Therefore, continuous follow-up and support from families, teachers, and peers are crucial for sustaining improvements in healthy food consumption over time. However, it is important to note that behavior change typically requires a longer duration to become stable. Previous research by Lally et al.⁽³³⁾ suggests that approximately 66 days are needed, on average, to establish a new habit. In contrast, the present study was conducted over a relatively short intervention period; therefore, the observed outcomes should be interpreted as short-term improvements in healthy food consumption rather than sustained behavioral change. Additionally, the use of self-reported measures among primary school children may introduce recall bias, as children may have limitations in accurately remembering and reporting their dietary intake.

Conclusion

The findings indicate that the V-Card Program is an effective approach for improving nutritional knowledge, attitudes, and healthy dietary behaviors among Grade 5 students. Therefore, it is recommended that the V-Card Program be implemented over an extended duration and integrated into school-based health promotion strategies. Additionally, incorporating interactive and learner-centered approaches, such as game-based learning, may further support long-term behavioral change among children.

Limitations of the Study

Despite the promising findings, several limitations should be considered. First, the study was conducted in a limited number of schools within a specific geographic area; therefore, the generalizability of the findings to other populations may be limited. Second, the duration of the intervention was relatively short, which may not fully reflect long-term behavioral changes among students. Finally, the assessment of dietary behavior relied on self-reported data, which may be subject to reporting bias.

Recommendations

Based on the findings of this study, it is recommended that future research should involve a larger sample size and include schools from different regions to enhance the generalizability of the results. In addition, longer intervention periods should be implemented to evaluate the long-term effects of the V-Card Program on students' dietary behaviors. Furthermore, integrating the V-Card Program into regular classroom activities or school health promotion programs may help strengthen students' nutrition knowledge and encourage healthier eating behaviors.

Ethical Approval Statement

This study was approved by the Ethical Committee for Human Research, Faculty of Public Health, Mahidol University, Thailand (MUPH 2024-049, May 2024). All of the students and guardians were informed about the objectives of the study and guardians were asked to sign the consent form.

Author Contributions

IM conducted the initiation and conceptualization of the hypothesis, research operations, data collection, data analysis, and results discussion, as well as prepared the manuscript. PK provided consultation on research process design, including making revisions based on recommendations from the Institutional Review Board, developing program and learning activities, questionnaire development, data analysis and article drafting; PC and WK guidance on designing questionnaire development and learning activities; All authors read and reviewed the article before submission for publication.

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Conflicts of Interest

The authors declare no conflict of interest.

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