

A Project Project entitled
**“Enhancing Primary School Students’ Physical Activity Level, Motivation and Fitness
Performance: Go Fitness Card Game”**

Submitted by

“Leung Ka Man”

Submitted to the Education University of Hong Kong
for the Bachelor Degree of Education (Physical Education)

in ***“April 2024”***

Supervised by

(“Associate Professor Dr. LEUNG Ka Man, Carman”)

Abstract of (Capstone Project) entitled
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Declaration

I, Leung Ka Man declare that this project report represents my own work under the Associate Professor and Dr. LEUNG Ka Man, Carman, and that it has not been submitted previously for examination to any tertiary institution.

Signed

Leung Ka Man

Date 14/4/2025

Abstract (Capstone Project)

Background: Recent evaluations from the Hong Kong report card indicate a decline in children's physical activity and fitness levels, with grades dropping from C- in Overall Physical Activity in 2018 to D- in 2022, and a D grade in Physical Fitness Level. This deterioration necessitates intervention to enhance physical activity and fitness among Hong Kong's children. **Purpose:** The project aimed to develop a card game to increase students' physical activity levels and fitness performance, while also motivating them to participate in physical activities beyond physical education classes. **Methodology:** The card game was designed for primary school students to play during recess in school. The card game was available for 2 to 6 players to play within 10 to 20 minutes per session. A total of 8 participants in the intervention group are tasked with completing various fitness and stretching exercises based on card instructions twice a week during recess in school, focusing on muscle strength, muscle endurance, flexibility, and cardiovascular endurance. The card game offers beginner and advanced levels to cater to different participant abilities, and includes both game cards and exercises demonstration cards. A total of 3 participants in the control group maintain their normal daily activity level during 8-weeks intervention. Evaluation for both groups was conducted fitness tests and questionnaires before and after the 8-week intervention. The intervention group would conduct a feedback form of Go Fitness Card Game after 8-weeks. **Results:** The intervention indicated a slight increase in intrinsic motivation, identified regulation and introjected regulation within the Intervention group to engage in physical activities, along with improvements in sit-up performance and 9-minute running assessments after 8 weeks. **Conclusion:** The 8-week card game intervention program exerted a slight positive effect on fitness performance, physical activity level, and motivation of primary school students to engage in physical activity.

(299 words)

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Background

According to the Active Healthy Kids Hong Kong report card, the evaluation of children's physical activity in Hong Kong revealed a decline in performance, with the Overall Physical Activity grade decreasing from C- in 2018 to D- in 2022. Furthermore, the Physical Fitness Level has consistently been assessed at a D grade from 2018 to 2022 (Active Healthy Kids Hong Kong, 2022). These findings indicate a deterioration in the current physical activity levels of children in Hong Kong, leading to suboptimal performance in both Overall Physical Activity and Physical Fitness Level. Physical inactivity is associated with negative consequences, including increased risk factors for noncommunicable diseases and mortality, thereby imposing a significant economic burden on society through rising healthcare costs and decreased productivity (World Health Organization, 2024).

Recent findings indicate that more than half of children continue to exhibit low levels of physical activity, resulting in poor fitness performance, particularly in terms of muscular strength and endurance. According to the Territory-wide Physical Fitness Survey in 2023, 66.3% of children did not meet the World Health Organization's recommended physical activity levels, which require an average of at least 60 minutes per day of moderate-to-vigorous physical activity throughout the week. Notably, only 15.7% of children perceived their activity levels as insufficient. Furthermore, the report indicated a decline in performance on the muscular endurance test (1-minute sit-up), with boys averaging 16.4 repetitions and girls 15.2 repetitions in 2021, as compared to 19.5 repetitions for boys and 18.7 repetitions for girls in 2012; The muscular strength test (Standing Long Jump) results show a decline for boys in 2021, with an average of 117.0 cm compared to 124.7 cm in 2012, while girls' performance has remained relatively stable at 111.1 cm, similar to 112.6 cm in 2012 (Community Sports Committee of the Sports Commission, 2023). Furthermore, a sense of pleasure was identified as the primary motivation for 49.1% of children engaging in

physical activity, nearly half of the total sample size (n = 426) (Community Sports Committee of the Sports Commission, 2023). These findings underscore the urgent need to enhance students' physical activity levels, with enjoyment being the key motivator for increased participation in physical activities.

Several studies have demonstrated that board games serve as an effective and engaging tool for motivating participants in learning activities. Firstly, board games have been identified as an enjoyable and motivational method for facilitating content learning and enhancing group interactions, as they require at least two participants, fostering entertainment and excitement through interpersonal interaction (Charlier and De Fraine, 2013). Secondly, the use of board games as a tool has been shown to positively impact the capacity for physical activity (Mouton et al., 2017). Thirdly, board games positively influence behavior by increasing student interest and appreciation (Amaro et al., 2006). As common entertainment activities within schools, board games indirectly encourage students to engage in more physical activities than they did previously. Overall, board games represent an effective strategy for enhancing the motivation of primary students to participate in physical activity.

Although the Hong Kong Government has initiated programs such as the “Active Students, Active People” Campaign for the 2021/22 academic year, which encompasses a series of physical education activities, including learning and teaching resources, aimed at encouraging students to actively engage in physical activities. This initiative seeks to help students meet the World Health Organization's recommendation of accumulating at least 60 minutes of moderate-to-vigorous physical activity daily on average across the week (Education Bureau, 2024). Despite these efforts, the campaign has not sufficiently motivated students to develop a regular exercise habit, as evidenced by findings indicating that the Overall Physical Activity grade was a D- and the Physical Fitness Level was a D grade in 2022 (Active Healthy Kids Hong Kong, 2022). The rate of achieving the WHO's recommendations remains notably low.

Therefore, this research aims to design a physical fitness card game that offers primary students a joyful and interactive means of increasing their participation in physical activities, thereby encouraging them to enhance their physical activity levels through gameplay.

Project objectives

1. To examine the effectiveness of card game activities on increasing primary school students' physical activity level and fitness performance.
2. To examine the effectiveness of card game activities on increasing primary school students' physical activity motivation outside PE class in school.

It was hypothesized that students in the Intervention group would have higher levels of physical activity, motivation, and fitness performance compared to those in the Control group following the 8-week intervention.

Methodology

Game Design

According to the Territory-wide Physical Fitness Survey in 2023, the main reasons for children participating in physical activity are a sense of pleasure (49.1%), making friends (32.8%), and maintaining good health and physique (30.6%) (Community Sports Committee of the Sports Commission, 2023). Based on the above results, to answer purposes #1 and #2, I designed a card game entitled "Go Fitness."

The Go Fitness Card Game is designed for primary school students to engage in during school recess or at home. Unlike traditional sedentary games, participants are required to perform a series of physical exercises. Each set accommodates 2 to 6 players and is designed to be completed in 10 to 20 minutes per round, ensuring minimal disruption to academic activities.

Participants are instructed to perform various fitness and stretching exercises, such as sit-ups, squats, jumps, or high knees, as specified on the cards. Additionally, the game provides opportunities to learn related sports knowledge. The card game is tailored with two difficulty levels to cater to the varying abilities of students—beginner and advanced.

In this game, participants are tasked with collecting two or three complete sets of fitness cards of the same color. The use of action cards facilitates the collection of a full set of fitness cards, thereby enhancing the excitement of the game. Specific game rules are implemented to increase students' physical activity levels and foster interaction among players. For instance, all players are required to perform the first exercise together upon the revelation of each fitness card. When a player is shown two fitness cards of the same color, they need to invite another player to perform the second exercise depicted on the card. Upon completing a set of fitness cards of the same color, the player must perform the final exercise indicated on the card independently. The card game is primarily designed to ensure participants engage in continuous exercise and stretching throughout the gameplay.

The physical fitness evaluations established by the Education Bureau primarily emphasize muscle strength, muscle endurance, flexibility, and cardiovascular endurance (Education Bureau, 2023). Consequently, the exercises featured in the card game are also centered on these components. The card game is composed of two parts: game cards and demonstration cards, each depicting various fitness and stretching exercises. The game cards specify the types of exercises and the required number of repetitions. The demonstration cards provide images of correct postures, written descriptions, and video demonstrations. Students can access video demonstrations by scanning the QR code on the demonstration cards if they require further clarification on how to perform the exercises.

Study Design

Participants

The study invited a total number of 11 senior primary school students with the age range from 9 to 11 years old, and divided into the Intervention and Control groups (see table 1).

Table 1. Sample Characteristics

	N	%
Age		
9 yrs old	4	36.4%
10 yrs old	3	27.3%
11 yrs old	4	36.4%
Gender		
Male	5	45.5%
Female	6	54.5%
Physical activity level		
School Sports team	4	36.4%
School Non sports team	7	63.6%
Group		
Intervention: Active (school sports team)	3	27.3%
Inactive (school non sports team)	5	45.5%
Control	3	27.3%
Grade		
Primary 4	4	36.4%
Primary 5	6	54.5%
Primary 6	1	9.1%

Procedures

Both groups were required to complete pre-intervention questionnaires and fitness tests. It aimed to gather initial data on their physical activity levels, motivation for participating in physical activities, and fitness performance prior to the commencement of the project. The Intervention group was required to engage in the card game for approximately 10 to 20 minutes, twice weekly, over an 8-week period. In contrast, the Control group was instructed to maintain their usual daily activities throughout the intervention period.

Measures

The questionnaire was structured into two components: students' motivation and level of physical activity, and feedback on the card game. For the first component, participants were required to complete the Physical Activity Questionnaire for Older Children (PAQ-C) to assess their physical activity levels in engaging in physical activities (refer to Appendix 1). This self-administered, 7-day recall instrument evaluates students aged 7 to 14 years and provides a summary physical activity score derived from nine items, each rated on a 5-point scale (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997). Additionally, participants were required to complete the Children's Perceived Locus of Causality Questionnaire (C-PLOC) to assess their motivation for physical activities. This instrument comprises 15 items, with three items corresponding to each of the five levels of motivational regulation, each rated on a four-point scale (Pannekoek et al., 2013). The questionnaire specific to the Go Fitness Card Game was utilized to gather participants' feedback in the Intervention group on the card game following the intervention.

In addition, the exercises incorporated into the card game are designed to enhance muscle strength, muscle endurance, flexibility, and cardiovascular endurance. Consequently, the fitness tests will comprise the standing long jump, 1 minute sit-up, sit and reach test, and 9 minutes run. The testing protocol, scoring tables, and assessment criteria will adhere to the guidelines outlined in the School Physical Fitness Award Scheme (Education Bureau, 2023). This adherence is intended to enhance the reliability and validity of the fitness tests in evaluating the effectiveness of the card game in improving the fitness performance of primary school students.

Data analysis

Data were analyzed using the statistical package for social science (SPSS v. 28.0). To answer the purposes #1 and #2, an independent sample t test was conducted to compare mean score differences between the Intervention group and Control group on pre and post fitness tests, physical activity level, and physical activity motivation. Paired sample t test was conducted to compare the mean score between pre and post fitness tests, physical activity level and physical activity motivation in the Intervention group before and after intervention.

Results

The objective #1 and #2 (To examine the effectiveness of game card activities on increasing primary students' physical activity level and fitness performance, and to examine the effectiveness of card game activities on increasing primary students' physical activity motivation outside PE class in school). The total sample size was 11 (N = 11), which consisted of the Intervention group (N = 8) and Control group (N = 3). An independent sample t test indicated no significant difference in mean scores between the Intervention and Control groups in terms of pre and post intervention fitness tests, physical activity levels, and motivation. Similarly, a paired sample t test revealed no significant difference within the Intervention group in the mean scores of pre and post intervention fitness tests, physical activity levels, and motivation.

Nevertheless, the Intervention results demonstrated a slight increase in intrinsic motivation, identified regulation, and introjected regulation within the Intervention group, contributing to increased engagement in physical activities. Additionally, Improvements were observed in sit-up performance and the 9 minutes running following the 8-week period. Feedback from the Go Fitness Card Game questionnaire suggested that the card game enhanced participants' motivation to engage in physical activities, leading to an increase in their physical activity levels.

Independent sample t test

Table 2. Mean scores differences between Intervention group and Control group on fitness tests, physical activity level and motivation before and after intervention.

Fitness tests	Group	n	Mean difference	SD	t	df	p																																																																																																																	
1 min sit up	Intervention	8	1.75	7.83	-.194	9	.850																																																																																																																	
	Control	3	2.67	2.08				Sit and reach	Intervention	8	-.25	2.82	-1.368	9	.204	Control	3	4.00	8.19	9 mins running	Intervention	8	1.25	2.12	.065	9	.950	Control	3	1.33	.58	Standing long jump	Intervention	8	-1.88	8.43	.575	9	.579	Control	3	-6.67	20.82	Physical activity motivation								Intrinsic Motivation	Intervention	8	.54	1.11	.296	9	.485	Control	3	.33	.58	Identified Regulation	Intervention	8	.60	1.31	.490	9	.199	Control	3	.20	.72	Introjected Regulation	Intervention	8	.54	1.28	1.032	9	.947	Control	3	-.37	1.35	External Regulation	Intervention	8	-.33	1.40	.320	9	.382	Control	3	-.67	2.08	Amotivation	Intervention	8	.29	.68	1.029	9	.008	Control	3	-.53	2.16	Physical Activity Level during weekdays	Intervention	8	-.30	1.22	.384	9	.455	
Sit and reach	Intervention	8	-.25	2.82	-1.368	9	.204																																																																																																																	
	Control	3	4.00	8.19				9 mins running	Intervention	8	1.25	2.12	.065	9	.950	Control	3	1.33	.58	Standing long jump	Intervention	8	-1.88	8.43	.575	9	.579	Control	3	-6.67	20.82	Physical activity motivation								Intrinsic Motivation	Intervention	8	.54	1.11	.296	9	.485	Control	3	.33	.58	Identified Regulation	Intervention	8	.60	1.31	.490	9	.199	Control	3	.20	.72	Introjected Regulation	Intervention	8	.54	1.28	1.032	9	.947	Control	3	-.37	1.35	External Regulation	Intervention	8	-.33	1.40	.320	9	.382	Control	3	-.67	2.08	Amotivation	Intervention	8	.29	.68	1.029	9	.008	Control	3	-.53	2.16	Physical Activity Level during weekdays	Intervention	8	-.30	1.22	.384	9	.455		Control	3	-.60	.872								
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Note. Mean Differences: the mean scores differences between pre and post intervention.

An independent sample t test was conducted to compare mean scores between Intervention group and Control group in pre and post fitness tests, physical activity level and motivation. There were no significant differences between the Intervention group and Control group in fitness tests, physical activity level and motivation (1 minute sit up ($t(8) = -.194$, $p = .850$), sit and reach ($t(8) = -1.368$, $p = .204$), 9 minutes running ($t(8) = .065$, $p = .950$), standing long jump ($t(8) = .575$, $p = .579$), intrinsic motivation ($t(8) = .296$, $p = .485$), identified motivation ($t(8) = .490$, $p = .199$), introjected regulation ($t(8) = 1.032$, $p = .947$), external regulation ($t(8) = .320$, $p = .382$), amotivation ($t(8) = 1.029$, $p = .008$) and physical activity level during weekdays ($t(8) = .384$, $p = .455$). The mean difference between two groups was the same ($p > .05$). The card game brought very slight improvement on the Intervention group because there was no significant difference among the two groups after 8-week intervention.

In the fitness test, the mean difference and standard deviation of the Intervention group was slightly increased in 1 minute sit up test ($M = 1.75, SD = 7.83$) and 9 minutes running ($M = 1.25, SD = 2.12$) when compared to the Control group after an 8-week period. Although both two groups have decreased in the mean differences of standing long jump, the result in the Intervention group ($M = -1.88, SD = 8.43$) was smaller than the Control group ($M = -6.67, SD = 20.82$). The findings suggest that the Go Fitness Card Game exerted slight positive effects within the intervention group, effectively mitigating the decline in fitness performance observed in comparison to the control group.

In the motivation, the mean difference and standard deviation between pre and post results of motivations items in the Intervention group were increased in numbers such as intrinsic motivation ($M = .54, SD = 1.11$), identified motivation ($M = .60, SD = 1.31$) and introjected regulation ($M = .54, SD = 1.28$), which were greater than the Control group. Both two groups have decreased in the mean differences of external regulation after intervention, while both the mean differences and standard deviation between pre and post results in the Intervention group ($M = -.33, SD = 1.40$) was smaller than the Control group ($M = -.67, SD = 2.08$). The results indicated that participants exhibited lower levels of external motivation to engage in physical activity; however, the Go Fitness Card Game served as a slightly effective tool in facilitating greater participation in physical activity among the Intervention group compared to the Control group. However, the results of amotivation of the Intervention group also increased after intervention ($M = .29, SD = .67$), while it decreased in the Control group ($M = -.53, SD = 2.16$). The findings suggest that the Go Fitness Card Game was effective in enhancing the intrinsic motivation, identified regulation and introjected regulation of the Intervention group to engage more frequently in physical activity and elevate their physical activity levels. However, it also appeared to slightly diminish their motivation to participate in the same physical activity over an extended period.

In physical activity level, the mean difference scores of physical activity level during weekdays in the Intervention group was decreased ($M = -.30$), The results indicated that the effectiveness of participating in the card game twice weekly over an 8-week period in enhancing physical activity levels was insufficient. Nonetheless, the outcomes in the Intervention group were still superior to those observed in the Control group.

Paired sample t test

Table 3. Mean scores of Intervention group between pre and post on fitness tests, physical activity level and motivation.

Fitness tests		Mean	Std. Deviation	Mean Difference	Std. Deviation Difference	<i>t</i>	df	Sig. (2-tailed)
1 min sit up	Pretest	29.00	7.09	-1.75	7.83	-.632	7	.548
	Posttest	30.75	8.03					
Sit and reach	Pretest	26.25	5.78	.25	2.82	.251	7	.809
	Posttest	26.00	6.74					
9 mins running	Pretest	14.38	1.85	-1.25	2.12	-1.667	7	.140
	Posttest	15.63	1.06					
Standing long jump	Pretest	139.38	16.57	1.88	8.43	.629	7	.549
	Posttest	137.50	12.82					
Physical activity motivation								
Intrinsic Motivation	Pretest	2.86	.96	-.54	1.11	-1.367	7	.214
	Posttest	3.40	.45					
Identified Regulation	Pretest	2.96	1.04	-6.00	1.31	-1.293	7	.237
	Posttest	3.56	.54					
Introjected Regulation	Pretest	2.41	1.06	-5.38	1.28	-1.190	7	.273
	Posttest	2.95	1.07					
External Regulation	Pretest	2.53	1.23	3.25	1.40	.657	7	.532
	Posttest	2.20	1.25					
Amotivation	Pretest	1.95	1.01	-2.88	.67	-1.21	7	.267
	Posttest	2.24	1.12					
Physical Activity Level during weekdays	Pretest	3.03	.96	.30	1.22	.693	7	.510
	Posttest	2.73	1.53					

A paired sample t test was conducted to compare mean scores of the Intervention group between pre and post fitness tests, motivation and physical activity level. There were no significant differences between pre and post of Intervention group in fitness tests, physical activity level and motivation in the scores ($p > .05$) from 1 minute sit up ($t(8) = -.632$, $p = .548$), sit and reach ($t(8) = .251$, $p = .809$), 9 minutes running ($t(8) = -1.667$, $p = .140$), standing long jump ($t(8) = .629$, $p = .549$), intrinsic motivation ($t(8) = -1.367$, $p = .214$), identified motivation ($t(8) = -1.293$, $p = .237$), introjected regulation ($t(8) = -1.190$, $p = .273$),

external regulation ($t(8) = .657, p = .532$), amotivation ($t(8) = -1.205, p = .267$), and physical activity during weekdays ($t(8) = .693, p = .510$).

In the fitness tests, the Intervention group were improved in the mean score such as 1 minute sit up ($M = (30.75-29.00) = 1.75$) and 9 minutes running ($M = (15.63-14.38) = 1.25$) after 8-week intervention. However, there were decreases in sit and reach ($M = (26.00-26.25) = -0.25$) and standing long jump ($M = (137.50-139.38) = -1.88$). Moreover, the difference of standard deviation on three fitness tests like 1 minute sit up ($SD = (8.03-7.09) = 0.94$), sit and reach ($SD = (6.74-5.78) = 0.62$) and 9 minutes running ($SD = (1.06-1.84) = -0.78$) were very small difference between pre and post intervention, except standing long jump ($SD = (12.82-16.57) = -3.75$). However, the intervention resulted in a marginal improvement in the mean scores of the one-minute sit-up and nine-minute running tests.

In motivation and physical activity level, the Intervention group were increased in the mean score of motivations such as intrinsic motivation ($M = (3.40-2.86) = 0.54$), identified motivation ($M = (3.56-2.96) = 0.60$), introjected regulation ($M = (2.95-2.41) = 0.54$). However, there were decreases in external regulation ($M = (2.20-2.52) = -0.32$) and increases in amotivation ($M = (2.24-1.95) = 0.29$). Therefore, it resulted in the mean of the physical activity level during weekdays also decreased ($M = (2.73-3.03) = -0.57$). Moreover, the difference of standard deviation on amotivation ($SD = (1.12-1.01) = .67$) was a very small difference between before and after intervention, while the difference of standard deviation in other four motivations were between the range of 1.0 to 1.4. It reflected that the difference in motivation between the Intervention group to participate in physical activity was small. Therefore, it did have very small enhancement in the motivations in intrinsic motivation, identified motivation and introjected regulation prior to and after intervention.

Go Fitness Card game Feedback (Appendix 4)

Table 6. Reasons of like or dislike to play the card game.

Q2. Please briefly explain why you like / dislike playing the Go Fitness card game.	
It's fun.	62.5%
It can do more exercises.	12.5%
It's easy to play.	12.5%
Fitness movements are repeating and boring.	12.5%

More than half of participants thought that the reason they liked to play the card game was because of fun (62.5%). Others thought that it could do more exercise (12.5%) and it was easy to play (12.5%).

Figure 4. Percentage of playing Go Fitness can increase physical activity level.

Q3. Do you think playing Go Fitness can help you increase your physical activity? (WHO regulations: Children and adolescents aged 5 to 17 years should e...vigorous intensity physical activities every day)
8 responses

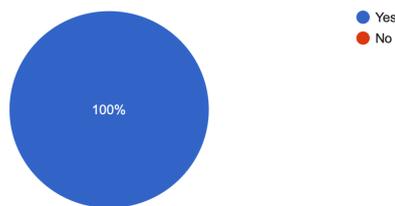


Table 7. Reasons for playing Go Fitness to increase physical activity level.

Q5. Please briefly explain why you would /would not be willing to play the Go Fitness card game to increase your physical activity level.	
It can increase the amount of exercise and physical activity level.	50%
It can increase the interest of doing exercise when playing it.	12.5%
It's fun and easy to play.	25%
It benefits our body health.	12.5%

All participants thought that playing the Go fitness Card Game could help them increase their physical activity level (see figure 4). Half of participants said that playing the Go Fitness card game could help them increase their physical activity level (50%). One quarter of participants said that it was fun and easy to play (25%).

Figure 5. Percentage of playing Go Fitness can improve physical fitness performance.

Q6. Do you think playing Go Fitness can help you improve your physical fitness performance? Physical fitness tests include: 1-min...s running, sit-and-reach, standing long jump, etc.
8 responses

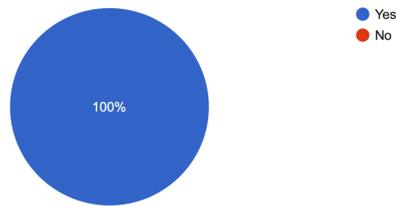
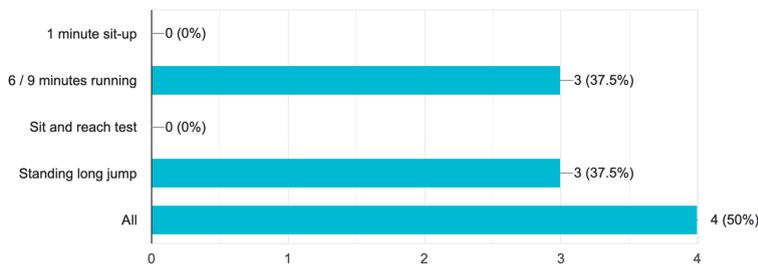


Figure 6. Percentage of fitness tests can be improved by playing Go Fitness.

Q7. Continuing with the previous question, which physical fitness test do you think playing Go Fitness can help you improve your performance? (can choose more than one)
8 responses



All participants said that playing Go fitness could improve their fitness performance (see figure 5). Half of participants stated that playing Go Fitness could improve all four fitness test items (50%). Just over a third of participants stated that 9 minutes running (37.5%) and standing long jump (37.5%) could be improved .

Figure 7. Percentage of choosing to play Go Fitness in P.E. lesson during rainy days.

Q9. If a P.E. teacher suggested playing the Go Fitness card game during PE class on a rainy day, would you be willing?
8 responses

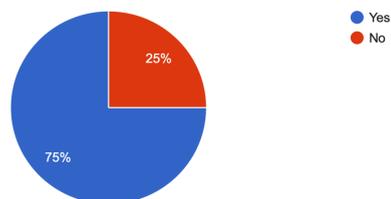


Table 8. Reasons for choosing to play Go Fitness in P.E. lesson during rainy days.

Q10. Please briefly explain why you are willing / unwilling to play the Go Fitness card game in P.E. lesson during a rainy day.	
Nothing I can do if I do not play it.	25%
It can increase physical activity even on rainy days.	25%
It's fun.	25%
Watching eTV is more fun than playing it.	12.5%
It is inconvenient to play in a covered playground without tables.	12.5%

Three quarters of participants stated that they were willing to play Go Fitness in P.E. lesson during rainy days (75%) (see figure 7). Moreover, the reasons for them wanting to play were because of fun (25%), nothing they can do in the classroom (25%) and increased physical activity level (25%). While some participants were unwilling to play it because of other attractive activities like watching eTV (12.5%) and the inconvenience of lacking tables(12.5%).

Discussion

Based on the low participation of Hong Kong primary school students in physical activity, this study aims to examine the effect of playing the physical fitness card game for 8 weeks to enhance their physical fitness performance, physical activity level and physical activity motivation. The 8-week card game intervention program did not yield statistically significant differences between the Intervention group and the Control group in terms of fitness tests, physical activity levels, and physical activity motivation before and after the intervention. This outcome may be attributed to several factors: the timing of the post-test, conducted immediately following a school examination week; participants' preference for beginner-level fitness exercises during the intervention; and the insufficient duration of 40 minutes per week for enhancing fitness performance. Consequently, the intensity of the Card Game program was considered low.

The aforementioned factors elucidate the lack of significant differences between the intervention and control groups concerning fitness performance, physical activity levels, and motivation. This outcome diverges from existing literature, which suggests that the giant exercising board game positively influences physical capacity, motivation, and quality of life among nursing home residents (Buckinx, 2020).

Slightly improvement in fitness performance

The findings indicated no statistically significant differences between pre- and post-fitness test scores among the intervention and control groups. Nevertheless, the Go Fitness Card Game intervention was associated with increased post-test scores in the 1 minute sit-up and 9 minutes running assessments. The card game primarily incorporates fitness exercises targeting the abdominal and thigh muscles, thereby contributing to a slight improvement in sit-up and running performance, and participants consistently engaging in fitness activities for 10 to 20 minutes during gameplay. Conversely, the results for the standing long jump and sit-and-reach tests showed no improvement, likely due to the leg exercises focusing more on muscle endurance and strength rather than flexibility.

Slightly enhancement in physical activity motivation

The findings indicated a modest increase in intrinsic motivation, identified regulation, and introjected regulation within the intervention group, which facilitated increased participation in physical activity. This enhancement in motivation may be attributed to the enjoyable nature and perceived health benefits associated with the Go Fitness Card Game, as these align with the reasons participants cited for engaging in physical activity, according to feedback from the pre-intervention questionnaire. Furthermore, there was a slight decrease in amotivation in the post-test, as participants expressed boredom from repeatedly engaging in the same physical activity over the 8-week period.

Slightly decrement in physical activity level

The physical activity levels of the intervention group experienced a slight decline following the intervention. This outcome may be attributed to the timing of the post-test, which was administered a week after school examinations. It is possible that their physical activity levels diminished slightly during the examination revision period, which may have also impacted their fitness performance results.

Limitation and recommendation for future research

The present study faced several limitations. First, the sample size was small ($N = 11$), with an unequal distribution between the groups, thereby limiting the capacity to compare the intervention group ($N = 8$) and the control group ($N = 3$) effectively. Second, the duration of the card game during weekdays was inadequate, as participants engaged in the activity only twice per week. Third, all participants selected the beginner level of fitness exercises, resulting in an intensity insufficient to facilitate significant improvements. Lastly, some participants did not fully engage in the post-intervention fitness test, leading to a decline in performance compared to their pre-intervention results.

Future studies could be conducted to resolve the above limitations. Studies should consider recruiting samples with large and equal distribution of primary school students, randomly assigning participants into Intervention and Control groups. Future research may increase the amount of volumes or frequencies of resistance training that are more effective for improving strength and muscle size (Grgic et al, 2018). Besides, it also could enhance the rigor of the intervention through improved supervision. Specifically, to make a better improvement in fitness performance, increasing the intensity of the fitness exercises by selecting the advanced level of the card game, and extending the duration of play each week to meet the standard of physical activity level for children in the World Health Organization. Moreover, it would be important to monitor and encourage participants to fully engage in post fitness tests by

providing rewards in order to examine the effectiveness of the card game to enhance their fitness performance.

Conclusion

The 8-week Card Game intervention program led to a slight improvement in physical fitness performance, specifically in sit-up exercises and nine-minute running, within the intervention group, although these improvements were not significantly different from those observed in the control group. The card game intervention exerted slight positive effects on the fitness performance, physical activity level, and motivation of primary school students to engage in physical activity. The results of the Go Fitness Card Game offer evidence-based insights for enhancing fitness performance, physical activity levels, and motivation among primary school students, suggesting that a more extended implementation period could yield greater improvements. Additionally, this study enriched my comprehension of physical activity and data analysis in the context of designing the Go Fitness Card Game and collecting relevant data.

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Appendix 1. Physical Activity Questionnaire (Children)

Name: _____

Age: _____

Sex: M F

Grade: _____

We are trying to find out about your level of physical activity from *the last 7 days* (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others.

Remember:

1. There are no right and wrong answers — this is not a test.
2. Please answer all the questions as honestly and accurately as you can — this is very important.

1. Physical activity in your spare time: Have you done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one \surd per row.) (P.E. lessons are not included)

	No	1-2	3-4	5-6	7 times or more
Skipping	<input type="checkbox"/>				
Rowing / Canoeing	<input type="checkbox"/>				
Dodgeball	<input type="checkbox"/>				
Walking for exercise	<input type="checkbox"/>				
Bicycling	<input type="checkbox"/>				
Jogging / Running	<input type="checkbox"/>				
Athletics	<input type="checkbox"/>				
Swimming	<input type="checkbox"/>				
Baseball / Softball	<input type="checkbox"/>				
Dance	<input type="checkbox"/>				
Football	<input type="checkbox"/>				
Badminton	<input type="checkbox"/>				
Rugby	<input type="checkbox"/>				
Table tennis	<input type="checkbox"/>				
Volleyball	<input type="checkbox"/>				
Tennis	<input type="checkbox"/>				
Basketball	<input type="checkbox"/>				
Gymnastics	<input type="checkbox"/>				
Handball	<input type="checkbox"/>				
Aerobic (eg.playing in the park etc.)	<input type="checkbox"/>				
Other:					
_____	<input type="checkbox"/>				
_____	<input type="checkbox"/>				

2. In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)? (Check one only.)

- I don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

3. In the last 7 days, what did you do most of the time *at recess*? (Check one only.)

- Sat down (talking, reading, doing schoolwork).....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

4. In the last 7 days, what did you normally do *at lunch* (besides eating lunch)? (Check one only.)

- Sat down (talking, reading, doing schoolwork)
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

5. In the last 7 days, on how many days *right after school*, did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

6. In the last 7 days, on how many *evenings* did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time last week
- 2 or 3 times last week
- 4 or 5 last week
- 6 or 7 times last week

7. *On the last weekend*, how many times did you do sports, dance, or play games in which you were very active? (Check one only.)

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

8. Which *one* of the following describes you best for the last 7 days? Read *all five* statements before deciding on the *one* answer that describes you. (Check one only.)

- A. All or most of my free time was spent doing things that involve little physical effort
- B. I sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- C. I often (3 — 4 times last week) did physical things in my free time

- D. I quite often (5 — 6 times last week) did physical things in my free time
- E. I very often (7 or more times last week) did physical things in my free time

9. Mark how often you did physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week. (Mark only one \surd per row.)

Always	None	Seldom	Sometimes	Often	
Monday	<input type="checkbox"/>				
Tuesday	<input type="checkbox"/>				
Wednesday	<input type="checkbox"/>				
Thursday	<input type="checkbox"/>				
Friday	<input type="checkbox"/>				
Saturday	<input type="checkbox"/>				
Sunday	<input type="checkbox"/>				

10. In the last week, did your physical activity level meet the WHO standards? (Check one only.)

(WHO regulations: Children and adolescents aged 5 to 17 years should engage in at least 60 minutes of moderate to vigorous intensity physical activities every day)

Accumulation of physical activity: Any form of intermittent physical activities, which last for 10 minutes or more, will be summed up.
Moderate-intensity physical activity: Activity leads to slightly speeding up of breathing and heart rate, and mild sweating without exertion.
Vigorous-intensity physical activity: Activity leads to greatly speeding breathing and heart rate, profuse sweating and exertion.

Yes No

11. Were you sick last week, or did anything prevent you from doing your normal physical activities? (Check one.)

Yes

No

If Yes, what prevented you? _____

12. What are the main reason(s) for you participating in physical activity?
(Please choose no more than 3 options)

(a) To Cope with daily needs.	<input type="checkbox"/>
b) Sense of pleasure.	<input type="checkbox"/>
c) To make friends.	<input type="checkbox"/>
d) To enhance self-confidence.	<input type="checkbox"/>
e)To control body weight.	<input type="checkbox"/>
f)To fill free time.	<input type="checkbox"/>
g) To maintain good health and physique.	<input type="checkbox"/>
h) Sense of success.	<input type="checkbox"/>
i) To develop various physical activity skills.	<input type="checkbox"/>
j) To develop leadership skills.	<input type="checkbox"/>
k) Arranged by parents.	<input type="checkbox"/>

13. What is/are the barrier(s) for you participating in physical activity?
(Please choose no more than 3 options)

a)Physical activity is too boring.	<input type="checkbox"/>
b) No appropriate venue nearby.	<input type="checkbox"/>
c) Too tired.	<input type="checkbox"/>
d) No peer company.	<input type="checkbox"/>
e) Too many rules to follow during physical activity.	<input type="checkbox"/>
f) Participating in physical activity makes me uncomfortable.	<input type="checkbox"/>
g) Physical activity participation affects academic results.	<input type="checkbox"/>
h) Too busy with homework.	<input type="checkbox"/>
i) Health issues.	<input type="checkbox"/>
j) Discouraged by family members.	<input type="checkbox"/>
k) Bad weather conditions.	<input type="checkbox"/>

Appendix 2. Children's Perceived Locus of Causality Questionnaire (C-PLOC)

Name: _____

Sex: _____

Grade: _____

The following is a list of reasons why people engage in physical activities, sports and exercise. Keeping in mind your primary physical activity/sport, respond to each question (using the scale given), on the basis of how true that response is for you.

1	2	3	4
“strongly disagree”	“disagree”	“agree”	“strongly agree”

(Circle the number)

Intrinsic motivation

- | | | | | | |
|----|--|---|---|---|---|
| 1. | I take part in physical activities because it is fun. | 1 | 2 | 3 | 4 |
| 2. | I take part in physical activities because I like learning new things. | 1 | 2 | 3 | 4 |
| 3. | I take part in physical activities because I enjoy doing it. | 1 | 2 | 3 | 4 |

Identified regulation

- | | | | | | |
|----|--|---|---|---|---|
| 1. | I take part in physical activities because I want to learn how to do new things. | 1 | 2 | 3 | 4 |
| 2. | I take part in physical activities because it is important for me to do well. | 1 | 2 | 3 | 4 |
| 3. | I take part in physical activities because I want to get better at it. | 1 | 2 | 3 | 4 |

Introjected regulation

- | | | | | | |
|----|--|---|---|---|---|
| 1. | I take part in physical activities because I want others to think I am good at it. | 1 | 2 | 3 | 4 |
| 2. | I take part in physical activities because I feel guilty when I don't. | 1 | 2 | 3 | 4 |
| 3. | I take part in physical activities because I want other people to think I am good. | 1 | 2 | 3 | 4 |

External regulation

- | | | | | | |
|----|--|---|---|---|---|
| 1. | I take part in physical activities because I'll get into trouble if I don't. | 1 | 2 | 3 | 4 |
| 2. | I take part in physical activities because I have no choice. | 1 | 2 | 3 | 4 |
| 3. | I take part in physical activities because that's the rule. | 1 | 2 | 3 | 4 |

Amotivation

- | | | | | | |
|----|--|---|---|---|---|
| 1. | I take part in physical activities but I don't know why we should have it. | 1 | 2 | 3 | 4 |
| 2. | I take part in physical activities but I feel I am wasting my time at it. | 1 | 2 | 3 | 4 |
| 3. | I take part in physical activities but I don't know the reason why. | 1 | 2 | 3 | 4 |

Appendix 3. Go fitness card game survey (students)

Name: _____

Sex: _____

Grade: _____

Please circle the options.

Q1. Do you like the Go Fitness card game?

Yes No

Q2. Please briefly explain why you like/dislike it.

Q3. Do you think playing Go Fitness can help you increase your physical activity?

(WHO regulations: Children and adolescents aged 5 to 17 years should engage in at least 60 minutes of moderate to vigorous intensity physical activities every day)

Yes No

Q4. Will you choose to play Go Fitness to improve your physical activity?

(WHO regulations: Children and adolescents aged 5 to 17 years should engage in at least 60 minutes of moderate to vigorous intensity physical activities every day)

Yes No

Q5. Please briefly explain why you would/would not be willing to play Go Fitness to increase your physical activity.

Q6. Do you think playing Go Fitness can help you improve your physical fitness performance?

Physical fitness tests include: 1-minute sit-up, 6 / 9 minutes running, sit-and-reach, standing long jump, etc.

Yes (answered 'Yes' in Q6, please answer Q7. directly.)

No (answered 'No' in Q6, please skip Q7. and answer Q8. directly.)

Q7. Continuing with the previous question, which physical fitness test do you think playing Go Fitness can help you improve your performance? (can choose more than one)

1 minute sit-up 6 / 9 minutes running Sit and reach test Standing long jump All

Q8. Please explain specifically why you think playing Go Fitness cannot help you improve your physical fitness performance?

Q9. If a P.E. teacher suggested playing the Go Fitness card game during PE class on a rainy day, would you be willing?

Yes No

Q10. Please briefly explain why you are willing or unwilling to play the Go Fitness card game during gym class on rainy days?

Q11. Are there any suggestions for improving the Go Fitness card game?

For example: card design/card content/physical actions/others...

Please be specific.

Appendix 4. Results of Card Game Feedback Form

<https://docs.google.com/forms/d/1f16hxB5lGoWBzzObDuWH-eYuRYmAFSxq5X6I9OW8jHw/viewanalytics>

Appendix 5a. Result of Pre Physical Activity Questionnaire

<https://docs.google.com/forms/d/1BP7i-tuVyoNu0eX3LDOgOd4dylpsTzxFUFhx2r8IKKc/viewanalytics>

Appendix 5b. Result of Post Physical Activity Questionnaire

<https://docs.google.com/forms/d/1SoHtF7QA50sMqDGtk5z1BjoCIiDv7uw0TVgfBoWErhc/viewanalytics>

Appendix 6a. Result of Pre Children's Perceived Locus of Causality Questionnaire

https://docs.google.com/forms/d/1Dcq5CA5xtElqocYzMC5OFa_eip-dfljHyhmryNUDyr4/viewanalytics

Appendix 6b. Result of Post Children's Perceived Locus of Causality Questionnaire

https://docs.google.com/forms/d/1nZomI9SxGII4XshwYE7_Q4oizccZF0U7R73cKkVAhMo/viewanalytics