Exergaming Effects on Secondary School Students' Interest to Participate in Physical and Health Education (PHE) Class

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ABSTRACT

Physical and health education class is a platform to promote and educate about physical activity which is important for children and teens to grow up healthy and helps avoid chronic diseases later in life. Now, there are declining student engagement in PHE due to factors such as excessive screen time and lack of motivation. Exergaming has emerged as a tool to promote active lifestyles by combining physical exercise with engaging video game elements. The purpose of this study was to determine exergaming effects on secondary school students' interest to participate in physical and health education (PHE) class. 40 participants from SMK Ceria participated in this experimental research which done within PHE class. Participants were divided equally into intervention (n=20) and control group (n=20). The participants' level of interest in PHE class were analyzed pre and post research using adopted Revised Situational Interest Scale. EEQ was used to determine the exergame enjoyment among participants in intervention group. Quantitative data were analyzed using descriptive statistics (frequencies, mean, SD) and inferential statistics (Mann Whitney U test and ANCOVA). At baseline, the control group reported higher level of interest in PHE class (mean rank = 30.53) compared to the intervention group (mean rank = 12.48). Later, the intervention group showed a significant increase in interest (mean rank = 30.50) compared to the control group (mean rank = 10.50). Students in the intervention group also reported high enjoyment levels during exergaming across all dimensions. There was a significant effect of exergaming on interest levels in PHE (Mann-Whitney U test, p = 0.000; ANCOVA, p = 0.002). In conclusion, this study concludes that exergaming has a significant positive impact on secondary school students' interest in participating in Physical and Health Education (PHE) classes. The results demonstrate that students in the intervention group exhibited higher levels of interest across all dimensions compared to those in the control group. Therefore, this study would provide significant baseline to integrate exergaming in PHE curriculum in Malaysia.

Keywords: PHE class, Student engagement, Education, Exergaming, Secondary school students

INTRODUCTION

According to Jeong and So (2020), physical education is distinctly separate from disciplines that are knowledge-based and focused on physical activity. The usual terminology for referring to the educational discipline is "physical education" (PE). Sterdt et al. (2014) stated that the purpose of PHE is to promote and educate about physical activity (PA) which is important for children and teens to grow up healthy and helps avoid chronic diseases later in life. It is one of the most important things to do for public health all over the world. Young people who are very active are less likely to have heart problems like high blood pressure, being

overweight, smoking, and type 2 diabetes. Physical exercise also improves cognitive skills and mental health, with the most noticeable effects on self-confidence and depression.

Term "exergaming" was defined by Sween et al. (2014) as an interactive fitness that combines physical activity and video gaming. American College of Sports Medicine claim that exergaming is the "future of fitness" which the objective is to encourage physical activity and promote health among children and adolescents. Globally, a significant proportion of adolescents are failing to meet the prescribed level of physical activity, as evidenced by Kalman et al. (2015), thereby exerting adverse effects on their physical and mental wellbeing, as highlighted by Lubans et al. (2016). According to Zulkifli and Danis (2021), students nowadays tend to become sedentary due to Covid-19 pandemic that make them physically inactive, spend more time on gadget and eat more junk food. Additionally, the present situation of having sedentary lifestyle among the students leads to people's lack of skills, deterioration of their muscles and brains, poor self-esteem, lack of drive, and feelings of estrangement from their peers (Bowden Davies et al., 2019). There are multiple factors that contribute to the decline in physical activity levels, one of which is the increased sedentary behaviour observed among children and adolescents, primarily attributed to their prolonged screen time. The potential of exergaming, also known as active video gaming, to increase physical activity levels among children and adolescents and consequently have a positive impact on their health has been suggested (Best, 2015).

During the past 10 years, several authors have emphasized the positive effects of exergaming, either towards physical activities, physical and health class or physical activities motivation among adolescents (Sun, 2013; Meckbach et al., 2014). However, the study did not explored more on the impact of exergaming on level of interest of school students' to participate in PHE class. One study by Roure et al. (2015) has come close by investigating high school students level of interest in PHE class based on dimension and physical activity level during exergaming. This study found that exergaming has proven to increase situational interest based on dimension, especially novelty and attention demand thus lead to physical activity benefits among high school students.

Even though these studies discussed on same topics of exergaming; however, the findings are not conclusive enough. First and utmost, the use of exergaming in educational settings in Malaysia is limited, with few studies exploring its effects in Physical and Health Education (PHE) classes. Most existing research has been conducted in countries like Sweden and the United States, therefore leaving a gap in data for Malaysian or Southeast Asian schools. This lack of localized research provides limited insights for teachers and policymakers in integrating exergaming into PHE classes, especially in a region where physical activity levels may vary significantly. Besides, prior research did not sufficiently examine the level of interest in PHE class across sociodemographic data such as gender, BMI or physical activities level among adolescents as these data could vary and influence the effectiveness of exergaming. In addition, few authors have addressed effectiveness of exergaming towards physical and health education class across different subgroups, however there were lacking of multi- dimensional interest analysis (Situational Interest Scale) used to determine specific dimensions from exergaming like enjoyment, novelty and fun affect the effectiveness of exergaming integration in the class.

Therefore, this study aimed to address the exergaming effects on secondary school students' interest to participate in physical and health education class by addressing the gaps in prior literature research.

METHODS AND MATERIALS

This was an experimental research of 40 school students aged 14 years old in Selangor. Research data was collected instantly before and post intervention. Researchers identify participants (n = 40) from random sampling to include in the study and divided into intervention group (IG) (n = 20) and control group (CG) (n = 20). This study used random sampling method to obtain respondent since this sampling design allowed data to be obtained based on respondents who are conveniently available to participate. Participant that fulfilled the inclusion criteria were required to have their parents to fill in the assent form before participating in the study. The participant's information sheet was also attached to the questionnaire to explain the purpose of the

study. Research ethics approval has been obtained from UiTM's Research Ethics Committee (Ref: ED/REC/F/1113, dated 29 April 2024).

The inclusion criteria of the respondents for this study were secondary school students, able to understand and speak Malay/English and free from any injuries at the beginning of study. Participants who have chronic known medical illness and experienced recent soft tissue injuries or fractures prior to the research were excluded. The level of interest in exergaming questionnaire was adopted from Chen et al. (1999) while the Exergaming Enjoyment Questionnaire (EEQ) adopted from Fitzgerald et al. (2020). The questionnaire is divided into 3 sections, which are sociodemographic data (Section A), Level of Interest in PHE class (Section B), and EEQ (Section C).

On the day of intervention, participants filled the section A and Section 2 prior to the intervention. Participants will participate in PHE class as usual according to their respective group. Intervention group started with induction phase where they familiarize with the Ring Fit Nintendo game control before starting the intervention while control group was taught as usual in PHE class. At the end of the intervention, intervention group answered level of interest in PHE class and exergame enjoyment scale while control group filled only the level of interest in PHE class.

Data analysis in this study was conducted using the Statistical Package for the Social Sciences (SPSS) version 28.0 for Windows. Descriptive statistics - frequencies, mean and standard deviation (SD) were calculated for data in the study (demographic data, level of interest in PHE class and exergaming enjoyment. Furthermore, inferential statistics – Mann Whittney U was used to test the effect between exergaming and level of interest in PHE class. To conclude, a significant relationship was determined when the result showed $p < 0.05$.

RESULTS

Demographic characteristics

This study involved 40 Form 2 students from 2 classes in SMK Ceria which then categorized into intervention group and control group. Both groups had equal numbers of male (40%) and female students (60%). The researcher determines the class of 2 U as intervention group while 2 S as control group. A total of 7 (35%) participants from intervention group and 10 (50%) from control group were categorized as normal based on Body Mass Index (BMI), while 9 (45%) from intervention group and 7 (35%) from control group were categorized as underweight.

Table 1: Demographic Data of participants

Demographic Data	**Intervention Group (n=20)**		**Control Group (n=20)**	
	N (%)	**(Mean ± SD)**	**N (%)**	**(Mean ± SD)**
Sex				
Male	8 (40)		8 (40)	
Female	12 (60)		12 (60)	
BMI (kg/m^2)				
Underweight	9 (45)		7 (35)	
Normal	7 (35)		10 (50)	
Overweight	3 (15)		2 (10)	
Obese	1 (5)		1 (5)	
Overall BMI		21.45 ± 7.46		20.55 ± 4.24
Height		159.30 ± 8.81		160.15 ± 10.87
Weight (kg)		56.65 ± 22.76		53.30 ± 15.10
Hours of exercising in a week		4.00 ± 3.162		5.20 ± 3.65

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For overweight category, a total of 3 (15%) from intervention group and 2 (10%) from control group were listed and the least category was obese, which had an equal number of participants in both groups, with 1 (5%) participant in each.

The total hours of exercise per week averaged 4 hours for the intervention group, while the control group averaged 5.20 hours.

Knowledge about exergaming

12 participants (60%) in the intervention group and 10 participants (50%) in the control group were not aware of exergaming, while 8 participants (40%) in the intervention group and 10 participants (50%) in the control group were aware of it (Table 2).

Table 2: Knowledge about exergaming

Knowledge about Exergaming	**Intervention group N (%)**	**Control group N (%)**
Yes	8 (40)	10 (50)
No	12 (60)	10 (50)

The sociodemographic characteristics and level of students' interest in PHE subject at baseline

Table 3 presents cross tabulation results between sociodemographic characteristics and the level of interest in PHE class at baseline of the 40 participants. Data suggest that BMI ($X^2 = 9.231$; $p = 0.026$) were significantly related to the level of interest in PHE class. This study assumed that the result may be raised from small sample size ($n = 40$). The Pearson Chi Square test has shown no significant difference among participants' gender and exercise hour. Lastly, none of the participants possessed a high level of interest in PHE subject at baseline regardless of their gender, BMI and exercise hours in a week.

Table 3: Sociodemographic Characteristics and Level of Interest in PHE class at baseline of 40 participants

Variables	**Level of Interest in PHE class**		
	High N (%)	**Average N (%)**	**Low N (%)**
Gender			
Male	0	16 (100.0)	0
Female	0	23 (95.8)	1 (4.2)
X^2 (df) = 0.684 (1); **p-value** = 0.408			
BMI			
Underweight	0	16 (40.0)	0
Normal	0	17 (42.5)	0
Overweight	0	3 (7.5)	0
Obese	0	3 (7.5)	1 (2.5)
X^2 (df) = 9.231 (3); **p-value** = 0.026*			
Average of exercise hours in a week			
1-3 hours	0	18 (45.0)	0
4-6 hours	0	7 (17.5)	0
More than 7 hours	0	14 (35.0)	1 (2.5)
X^2 (df) = 1.709 (2); **p-value** = 0.425			

Effect of exergaming on level of students' interest in PHE subject

Figure 1 and 2 shows the distribution of the responses based on level of students' interest in PHE subject. The pre-intervention data on level of student interest in PHE revealed notable differences between the intervention and control groups across five dimensions: exploration, enjoyment, attention, challenge, and novelty. At baseline, both groups exhibit almost similar scores in every dimension, where intervention and control group both show average level of interest (55.60±6.92) and (65.55± 5.93) respectively. Across dimensions, enjoyment dimension shows highest scores (15.15 ± 2.32) and (19.00 ± 3.78) for both group while novelty was among the lowest with intervention group (5.05± 1.73) and control group (10.55± 2.54).

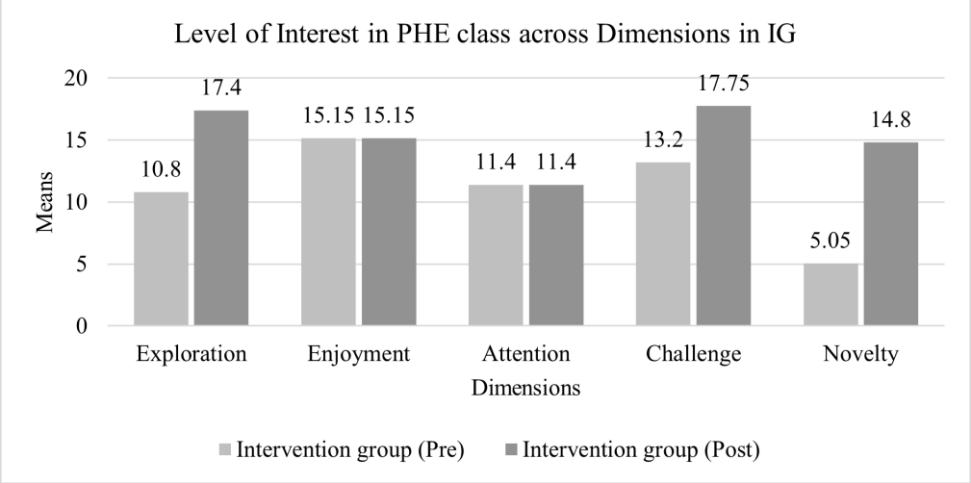

Figure 1: Level of Interest in PHE class across dimensions (IG)

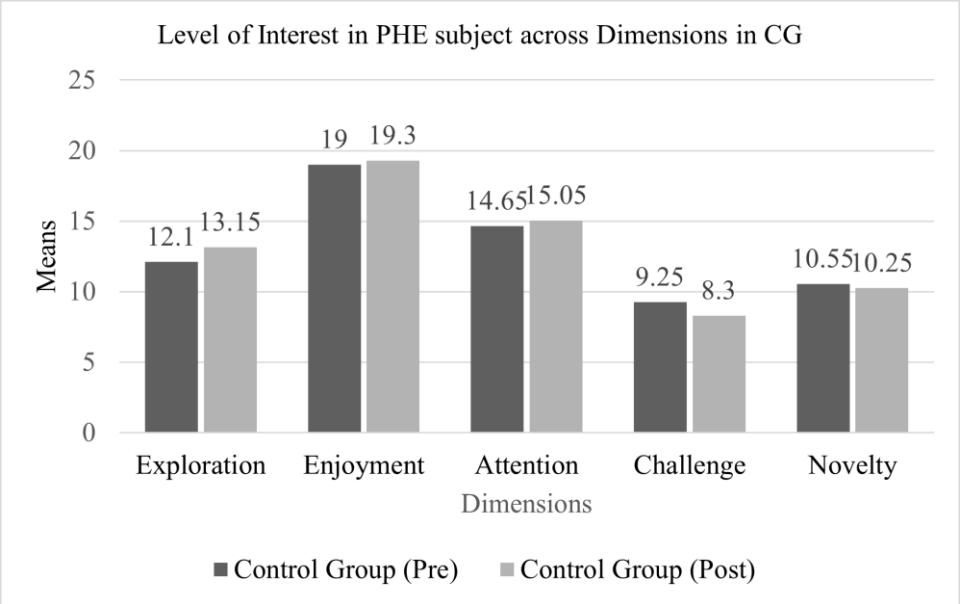

Figure 2: Level of Interest in PHE class across dimensions (CG)

A Mann-Whitney U test (Table 4) was conducted to examine the effect of exergaming on the level of interest of school students in PHE subject between students who received traditional PHE class and those who received exergaming intervention in PHE class (Table 8). At baseline, the control group reported significantly higher interest in PHE class compared to intervention group with mean rank of 30.53 and 12.48 ($p = 0.000$). However, post intervention, the intervention group demonstrated higher interest level in PHE class with mean rank of 30.50 while the mean rank for control group was 10.50. The post intervention result showed significant difference between the two groups ($p = 0.000$), suggested that exergaming intervention effectively increased level of interest of school students in PHE subject.

Table 4: Analysis of Mann Whitney U test

	Intervention Group	**Control Group**	**Intervention Group**	**Control Group**
	Pre intervention		**Post intervention**	
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Average[b]	55.60± 6.92	65.55 ± 5.93	90.20 ± 5.217	66.05 ± 5.78
Mean rank	12.48	28.53	30.50	10.50
p-value[a]	0.000		0.000	
[a]Mann Whitney U Test				
[b]Level of interest score: Low (20-59); Average (60-79); High (>70)				

Since both results were significant pre and post intervention, a between group analysis of covariance (ANCOVA) was conducted to further evaluate the positive effect of exergaming on the level of interest of school student in PHE class, with pre intervention scores as covariates (Table 5). Consistent with the research findings, exergaming was positively and significantly increased level of interest in PHE class among school students, $F(1,37) = 11.361$, $p = .002$. After controlling the pre intervention scores, a significant effect also obtained for group condition, $F(1,37) = 205.831$, $p < .001$.

Table 5: Analysis of covariance (ANCOVA) summary table for exergaming effectiveness by pre intervention scores and group condition

Source	**SS**	**df**	**MS**	**F**	**p**
Pre intervention scores	271.13	1	271.13	11.361	0.002*
Group	4912.23	1	4912.23	205.83	< 0.001*
Error	883.02	37	23.87		
Total	251127.00	40			
SS sum of squares, MS mean square					
*p < 0.05					

Exergaming interest among school students

Figure 3 and 4 showed result of exergame enjoyment questionnaire which was measured in the intervention group post the intervention to measure the exergame experience in five different dimensions which are Fun, Challenge, Engagement, Novelty and Preference. Across all dimensions, there were 4 dimension which received consistently high scores in all items which are fun (4.55), challenge (4.675) and novelty (4.45) and preference (4.65).

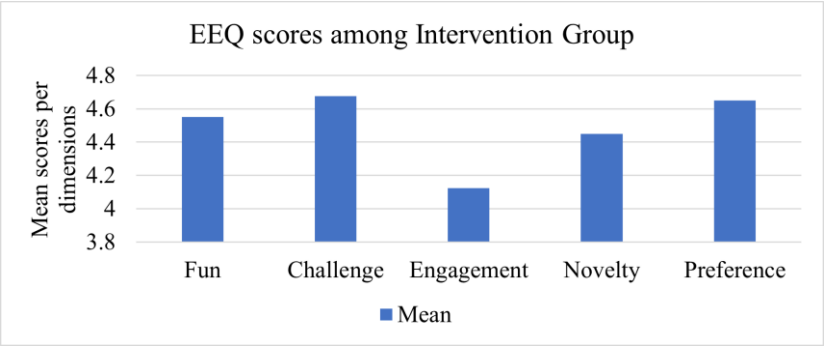

Figure 3: Mean scores of EEQ per dimension

However, despite higher score of these dimensions, lower rating was observed in some items in engagement dimension (4.125). Figure 4 showed mean scores per item in each dimension where participants did not lose

track of time while playing (3.80 ± 1.28) and neutral while involved in the world of game (3.65 ± 1.14). This is same as emotional attachment to the game in Fun dimension that was rated relatively lower than average (2.95 ± 0.95) compared to other items. In the dimension of fun, the highest rated item was "I felt that I wanted to keep playing" (4.75 ± 0.44), showing that participants had strong motivation to keep playing. They also experience sense of accomplishment from playing the game, which is good to foster long term exercise habit. Besides, participants rated positive high scores regarding the exergaming difficulty and challenge. Item "The game provided enjoyable challenge" scored highest (4.85 ± 0.37), suggesting that the exergame difficulty and challenge are suitable towards participants' level. Finally, participants highly appreciated the game elements as part of physical activity (4.85 ± 0.37). However, lower rating was given for the game responsiveness (3.85 ± 0.93) indicating rooms for improvement in technical area.

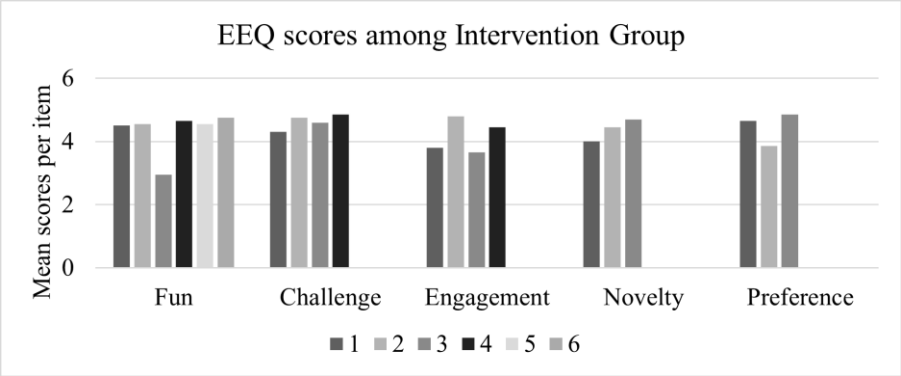

Figure 4: Mean scores per item in EEQ

DISCUSSION

Physical and health education is recognized as a comprehensive health dimensional field that has recently gained support from a number of educational systems all around the world (Lynch & Soukup, 2016). Sterdt et al. (2014) stated that the purpose of PHE is to promote and educate about physical activity (PA) which is important for children and teens to grow up healthy and helps avoid chronic diseases later in life. Physical exercise also improves cognitive skills and mental health, with the most noticeable effects on self-confidence and depression. According to Rebenitsch and Owen (2016), exergames are video games that encourage active play. There are many benefits of exergaming that are suitable for school students such as it can reduce the sedentary behaviour (Kari, 2014) and it ensure students enjoy the game while doing the physical activities because it involves many movements (Sun, 2013).

From the baseline, the participants have moderate level of interest in participation in PHE class. These findings are consistent with previous literature where they highlighted that generally students have low interest in participating in PHE class. At baseline, the moderate level of interest in PHE class may attributed to several factors including lack of unique and new experience that led to reduced interest to participate in PHE class. This study found that the repetitive nature of PHE class has failed to emphasize on fresh and engaging activity for students. This is supported by González-Cutre and Sicilia (2019) which reported that positive effects from novelty satisfaction was found on satisfaction with physical education class, thus suggest the importance of educators to provide novelty support in PHE class. This is also supported by study by Shkola et al. (2022) showed that engagement of student in physical education class before introduction of fitness aerobics improve from 86% to 96% after the introduction of fitness aerobics. Study by Kolovenis et al. (2023) also suggested that exergaming implementation has attracted students' interest in engaging in PHE class compared to traditional PHE class.

The current study also attempts to explore the association of level of school students' interest in Physical and Health education (PHE) class with the sociodemographic data of the participants. The study indicated that only BMI was significantly associated with level of interest in PHE class. The findings in consistent with previous literature by Ding and Jiang (2020) which showed that overweight and obese students have excess

body mass leading to restriction of movement, therefore they required more energy to perform physical activities compare to students with normal weight. This caused them to avoid physical activity. Also, previous studies by Mak et al. (2010) and Lopes et al. (2019) concludes that underweight and overweight/obese students induced negative effects on both physical activities and physical level. Hence, the consistency with existing literatures strengthens the current study results as the population size was small.

In this study, control group showed greater interest in PHE class compared to the intervention group at baseline. However, after implementing exergaming in the intervention group, they have showed a significant improvement in the level of interest' to participate in PHE class. This is consistent with previous research where exergame increased students' engagement in PHE class in term of enjoyment and focus (Lwin & Malik, 2012). In a randomized controlled trial by Ketelhut et al. (2022), they study the effects of a school-based exergame intervention on physical fitness among students. The study indicates positive effect of exergaming to increase physical fitness among students as physical fitness was strongly associated with increase physical activity participation. This is also aligned with a study on exergame conducted in South Korea, researcher found that learning with exergaming and wearable technology was more efficient as players were more engaged and their heart rate was increased during the activity (Lindberg et al., 2016). Also, study from Benzing et al. (2016) stated that asides from promoting physical activity, playing exergames can also enhance cognitive skills of students. The cognitive advantage witnesses the ability of exergames to challenge users in activities that include problem-solving, strategizing, coordination, and making decisions quickly.

Therefore, conclusion can be drawn here is exergaming is effective due to its ability to address the lacking dimension in traditional PHE class which is novelty and challenge. Exergaming offers significant interactive and fresh approach in physical activity compared to traditional PHE class, thus increasing their engagement and participation. There is also significant improvement in challenge which highlight the repetitive nature of traditional PHE class compared to exergaming which offers suitable difficulty and challenge towards students' level.

The Exergame Enjoyment Questionnaire (EEQ) revealed high levels of enjoyment among students in the intervention group across all dimensions. Majority of the students found exergaming to be very engaging and enjoyable as they felt motivated to continue playing the game and the game provided an enjoyable challenge. These finding suggest that exergaming has addressed students' need for engaging and challenging physical activity while participating in PHE class. Besides, EEQ dimensions like Engagement and Novelty demonstrated that students appreciated the unique and fresh perspective on physical activity brought by exergaming. Exergaming has the ability to engage students' participation in physical activity as they provide interactive aspect of learning. From the study, enjoyment act as a critical factor in ensuring participation in physical activity which high scores items like "I feel excited about the physical activities in the game" suggested that exergame fostered a positive emotional connection with physical activities in PHE class. The findings from this study also aligned with previous literature which highlight the importance of enjoyment in exergaming toward physical activity thus participation in PHE class. Study by McDonough et al. (2021) mentioned that exergame can help students to think about playing game instead of normal activity, therefore they will become more motivated to participate in class sessions. In another study by Omarov et al. (2024) investigating Augmented Reality (AR) game – based learning environment on enhancing motivation and physical activity in sports education suggest that intervention group exhibited significantly higher motivation and physical activity compared to control group. This is aligned with the current study finding where exergame promoted student participation and enthusiasm. Omarov et al. (2024) also added that integration of exergaming in the PHE class curriculum could enhance the learning dynamics and outcomes in PE.

CONCLUSION

This study concludes that exergaming has a significant positive impact on secondary school students' interest in participating in Physical and Health Education (PHE) classes. The results demonstrate that students in the intervention group, who engaged in exergaming, exhibited higher levels of situational interest across all dimensions—exploration, enjoyment, attention, challenge, and novelty—compared to those in the control

group who participated in traditional PHE activities. The most notable improvement was in the novelty dimension, where exergaming provided a fresh and engaging experience that overcame the repetitive nature of traditional methods. The study found a significant positive effects of exergaming and level of school students' interest to participate in PHE class and sets the foundation for further research into its long-term benefits and broader applications.

Limitation(s)

There are several limitations in this study that need to be addressed. First, this study involved school students which they are bound by their respective class schedule and school's busy schedule especially. This leads to the study duration may have been too short to capture the long-term effects of exergaming on student interest and participation. The sample size was also relatively small, which may limit the generalizability of the findings to a broader population. Additionally, each student's preferences, goals, and skill levels may vary, which might impact their participation and enjoyment of exergaming. Some people may find it inspiring and pleasant, while others may not connect with the technology or gaming part, restricting its applicability to certain groups. Lastly, the limitation of this study is this study did not delve deeper into specific potential long-term impacts of exergaming on the levels of physical activity, adherence, and overall health outcomes. Lastly, sociodemographic factors, such as prior gaming experience or access to technology, were not fully explored, which could influence students' baseline interest and their response to exergaming interventions. Addressing these limitations in future studies would provide a more comprehensive understanding of the impact of exergaming on PHE engagement.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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