

The Exergame Roles in Physical Activity Adherence among Pre-Service Teachers: A Follow-Up Study

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ABSTRACT

This study is designed to determine students' use of exergame and physical activity (PA) adherence levels using the PA Adherence Questionnaire. Specifically, this study focuses on the exergame's role in promoting higher PA levels among participants. Additionally, this study would also attempt to identify the main factors in exergame that influence PA adherence as well as using several modifiable factors to propose practical strategies to improve and maintain lifetime PA. This follow-up study involves a quantitative approach with the same students in the initial study (i.e., 33 participants, mix-genders with an age range between 20-25 years old) comprising undergraduate-level physical and health education (PHE), biology, and chemistry students at a local university in central peninsular Malaysia. The researcher used a questionnaire as the instrument to evaluate this follow-up study. Furthermore, the Statistical Package for Social Sciences (SPSS) (version 28.0) was utilised to analyse the variables in this study. The majority of participants fall into the "adherence possible" with the minority falling into the "adherence likely" categories in the PA adherence ratings. Specifically, participants tend to associate exergame with space and freedom when engaging in PA. Although social support values were generally high, receiving support from the lecturers was rated the highest followed by friends and family respectively. Nonetheless, knowledge, skills, and self-esteem were interdependent factors which could also determine the likelihood of PA adherence.

Keywords: Adherence, Exergame, Equipment, Physical activity, Social Support

INTRODUCTION

Malaysians like to play video games. A recent survey on Malaysia's online gamers found that 80% of Malaysians aged between 18 and 34 years considered themselves online gamers and 60% of the gamers were male (Oppotus, 2021). Unlike the typical stereotype, 64% of Malaysia's online gamers have a full-time job and 50% of them are professionals (e.g., managers, executives, and businessmen). The survey continues to report that the main motivational factors to engage in online games include socialising with other gamers, feeling immersed in the game, and wanting to have a sense of belonging (e.g., clan, squad) (Oppotus, 2021). Most of the respondents suggest that they prefer to play online with their real-life friends while some spend their time watching a live gaming stream to catch up with their idols, learn new strategies to play the game and get to know updates about their favourite game (Oppotus, 2021).

This study was meant to follow up with participants after the initial intervention with exergame in the year 2021 (Zulkifli & Danis, 2022). Briefly, the study was conducted with 45 mix-genders participants for 14 weeks during the online distance learning semester at the authors' university. The participants were

introduced to exergame the Fitness RPG [Shikudo Inc] and assigned as part of their assignment for the individual sports subject. There were no specific instructions given concerning what, when, where, and how they should collect the steps to convert energy and win missions. Nonetheless, the researchers occasionally provided prompts such as reminders, ideas of activities to do at home and interval checks on participants' progress to ensure they remained on-task and motivated throughout the intervention study.

Participants in that initial study reported many benefits from exergame intervention such as (1) higher willingness to learn new content, (2) more options to keep healthy throughout the semester, (3) working harder to study and keep fit, (4) higher engagement between educators and peers, (5) more fun associated with PA, and (6) reduce sense fear of failure among participants as the game promotes higher ownership and self-paced (Zulkifli & Danis, 2022).

Therefore, the main aim of this study was to investigate the participants' current engagement with exergame and how it affected their lives. The findings of this study would add depth to the issues post-exergame and propose strategies for meaningful and sustainable use of exergame in our PHE lessons. Additionally, this study will continue to advocate teaching and learning PHE in Malaysia with planned technology through the findings and discussion of this study. Importantly, this follow-up study looks to address the following research questions: (1) how does exergaming contribute to increasing levels of physical activity effectively? (2) what are the primary exergaming elements that impact adherence to physical activity? and (3) what are some adjustable factors that can enhance and sustain physical activity levels among participants?

LITERATURE REVIEW

Exergame Roles in Physical Activity

The introduction of the exergame concept was welcome at all levels of physical education. Specifically, exergame was defined as a game for health where the game mechanics and play encourage the players to engage in various body movements to move the game forward, leading to higher PA levels and better health (Baranowski, 2016). The integration of games and body movement was seen as capable of addressing the need to improve health, motor skills, and cognition while reducing boredom and discomfort associated with traditional physical activity (Donnelly et al., 2016). Additionally, exergame can serve as a substitute for playing sports when individuals are not able to play the sports physically due to factors such as injuries or weather (Corbin et al., 2009). In a meta-analysis study related to exergame, the researchers concluded that purposeful and meaningful use of technologies was capable of promoting light-to-moderate intensity PA (Peng et al., 2011). For example, a comparison study with 60 college students on exergames and treadmill walking found that participants reported lower ratings of perceived exertion (RPE) during exergame sessions but significantly higher RPE during treadmill walking activity. Therefore, exergame could help increase the duration of PA activities, energy expenditure, and the likelihood of lifetime PA participation (McDonough et al., 2018). Additionally, another study which integrate game and bicycle ergometers found that the intervention group utilised around 90% of their time engaging in moderate-vigorous physical activity (MVPA) in 15-minute sessions. Surprisingly, their control group relying only on the 15-minute time feedback also recorded 95% of time engaging in MVPA. They continued to explain that the fact participants were from sports science courses may result in unexpected disparity (Pasco et al., 2017). Meanwhile, a systematic review of exergames' effects on rehabilitative exercise among seniors found that the majority of studies reported improvement in all aspects of some aspects that have been tested. Specifically, 10 out of 11 studies demonstrated improvement in attributes such as balance among seniors through prolonged exergame intervention (Zeng et al., 2017).

The exergame is a great opportunity for us to learn about the newer generation's thoughts and needs and use their current interest to promote physical activity. The teaching and PA must be in sync with the students to

help them realise the values of engaging in PA and wellness. Sheehan and Katz (2010) have suggested six components (6Cs) that must be present in the exergame (1) control, (2) challenge, (3) curiosity, (4) creativity, (5) constant feedback, and (6) competition to intrinsically motivate individuals to engage in PA. Briefly, control refers to the freedom of participants to start, pause, select levels, and restart the game. The challenge revolves around constant demand and obstacles participants encounter in the exergame while curiosity refers to suspense or mysteries which prompt participants to continue playing the exergame (Sheehan & Katz, 2010). Additionally, creativity in the exergame promotes experimentation (try-and-error) in the process of problem-solving while constant feedback provides participants with artificial details and information on the participant's progress in the exergame. Besides that, the element of competition provides opportunities for participants to play against opponents and experience the feeling of success or failure (Gao, 2017). These exergame elements integrated with regular PE were deemed a better approach than regular PE to modify participants' PA beliefs and behaviours (Rose et al., 2017).

Physical Activity Adherence

The ever-increasing challenge for Malaysian to meet the minimum requirement of the World Health Organisation (WHO) recommendation of 60-minutes per day of physical activity and the country's status as the number one country in South East Asia with an obese population further added pressure for us to understand the whole context and start doing meaningful intervention to mitigate the problems and promote better health practice among Malaysian (WHO, 2022; Murugesen, 2022). For instance, Malaysia's National Health and Morbidity Survey (NHMS) 2022 among 33,523 students aged between 13-17 years old found that one in three individuals is either overweight or obese, four in five individuals does not eat enough fruits and vegetables, and four in five individuals in group age are physically inactive (NHMS, 2022). Adherence was defined as the adoption and maintenance of healthy behaviours throughout our lifetime (Corbin et al., 2009). Past studies related to PA adherence tend to demonstrate declining trends of PA levels among individuals from high schools to universities. Nonetheless, regular involvement in PA during schoolyears may increase the likelihood of individuals establishing lifelong healthy lifestyles (Corbin et al., 2009; Schmidt et al, 2016).

Physical activity adherence was also influenced by several factors mainly (1) personal factors, (2) environmental factors, and (3) programmatic factors. Specifically, environmental factors were normally associated with access to the facilities, neighbourhood safety, weather conditions, and perceived social support networks. The programmatic factors refer to the design of the exercise programme, the variety of activities as well as the level of supervision or guidance available for the students. Perhaps, the most important factor determining PA adherence was the personal factors shaped by the individual's self-efficacy, perceived benefits of PA, motivation, enjoyment during PA and past experiences related to the PA (Staiano et al., 2017; Rose et al., 2017).

Maintenance of Exergame

Despite previous studies suggesting that exergames were only capable of achieving light-to-moderate PA intensity (Peng et al., 2011), many of the participants were able to improve their PA levels beyond studies intervention. For instance, a follow-up study (i.e., two semesters from the initial study) with schoolchildren on exergames and PA levels found that PA levels were significantly higher compared to the initial study (Sun, 2013). A study with college students also found that experienced participants were able to perform the activity at a higher level of intensity compared to non-experienced participants (Gao, 2017). These results give us a sense of optimism that exergame concepts could help promote and sustain PA.

Nonetheless, many studies nowadays are now interested in the maintenance of exergames among individuals beyond class settings. More studies reported that improvement in PA levels tends to be short-

term and not much different compared to regular PE classes. Staiano et al (2017) found that after the initial improvement of PA with exergame introduction to children, participants tend to demonstrate a reverse effect at the mid and end points of the intervention. They continue to suggest that exergame should remain as an alternative and not as a substitute for regular PA. Moreover, a study by Playnomics (2012) found that 95% of new gamers tend to stop playing exergames within three months after initial introduction to the games. Another study suggested changes in situational interest in aspects such as challenges and exploration might lead to significantly lower PA levels with exergame in the follow-up study (Sun, 2013). Therefore, the exergame concept can be used as an additional learning tool to provide stimulus and encourage students who might start to lose interest in regular PE (Rose et al, 2017). It was worth noting that factors such as age levels, gender, heredity, and current health and fitness levels were important determinants of PA adherence among individuals (Corbin et al., 2009). For instance, despite having relatively similar scores of the metabolic equivalent of task (METs) between boys and girls, the studies found that boys perceived their exergaming experience as much more enjoyable and rewarding compared to girls (Hamlen, 2010; Rose et al., 2017).

Therefore, the mere addition of exergames in physical education might not be sufficient to promote behaviour modification but purposeful planning and integration in lesson plans can help students to see values in the exergames concept. Additionally, guidance and continuous support from educators for students engaging in exergame should also lead to a higher likelihood of physical activity adherence.

METHODOLOGY

This study was conducted as a follow-up study built upon the previous investigation with the same group of participants (Zulkifli & Danis, 2022). Using a quantitative approach, this study seeks to collect information related to exergame and PA adherence among many participants in the shortest period (Sharma, 2017). The positivist approach seeks to understand the issues objectively with an acceptable level of validity and reliability to maintain the quality of this research. Besides that, the quantitative approach is capable of highlighting either the relationship or effects between exergame and PA adherence (Mills, 2014).

Settings

They were 45 participants aged between 20-25 years old pre-service teachers involved in this follow-up study. Recalled, the convenience sampling technique was used in this study involving participants from three education departments (i.e., physical education (PE), biology, and chemistry) who were recruited via enrolment in the individual sports subject between October – February 2021 and completed their subject and intervention during the semester of online distance learning (ODL). Specifically, there were 13 males and 32 females with 11% (5) from East Malaysia and 88% (40) from West Malaysia participating in this study. There was no new intervention introduced in this study apart from the questionnaire provided to the participants.

Procedures

The initial study was conducted with the participants during whole-semester online distance learning to explore participants' understanding of the exercise the Fitness RPG [Shikudo Inc.] and the game's roles in shaping an individual's experience towards physical activity (Neubauer et al., 2019). The game was introduced as part of their assignment for individual sports subjects. Apart from rubrics and goals of completing the tasks, the participants were not given specific instructions on what, when, where, whom, and how they should collect the steps to convert energy and win missions. Occasionally, the researcher provided the participants with reminders of the benefits of PA during ODL, ideas of activities (e.g., jogging, house chores), and occasional checks on their progress to support participants'-maintained motivation throughout

the intervention study. A short time was allocated at the beginning of each class to reflect and discuss strengths and issues revolving around playing the game (e.g., Internet connection, marketplace, strategies in winning battles) (Zulkifli & Danis, 2022).

Questions regarding exergame capabilities to promote PA adherence become the basis of this study. The researcher has spent time during the semester break planning and devising the study design which includes a literature review to gain insights on PA adherence and the role of exergame, meeting experts to discuss the aims, objectives, and methodological issues of this study. The next process involved the researcher reestablishing contact with the participants from the initial study to inform them about the study purpose, benefits, and potential risks (if any) associated with participation in this study. Once the students fully understood and all questions were satisfied, the participants were invited to complete the short questionnaire. Answering the questionnaire represents their consent to participate in this follow-up study. The participants were assured any outcomes from this study, would not affect nor change the evaluation marks they would receive at the end of the semester. Additionally, participants may choose not to participate by not answering the questionnaire without any consequences. Ethical approval was obtained from the university research ethics committee before the beginning of this study.

Instrument

The PA adherence questionnaire was developed to explore the factors influencing PA adherence and identify modifiable factors so that the researcher can suggest strategies and solutions to improve PA levels and maintain a healthy lifestyle (Corbin et al., 2009). There were 12 questions divided into three sections (1) predisposing factors, (2) enabling factors, and (3) reinforcing factors. A Likert scale ranging from one to three (e.g., 1= not true and 3 = very true) was used in the questionnaire to objectively assess participants' answers and determine the scores. The total score from each section was then added to get the total score and categorised their scores into adherence levels (e.g., likely, possible, and unlikely) (Corbin et al., 2009).

Data analysis

Apart from total scores from all three sections of the questionnaire to categorise the participants into several adherence levels (e.g., likely, possible, and unlikely), the Statistical Package for the Social Sciences (version 28.0) was also used to analyse data. Descriptive statistics, that is means, standard deviation (SD), and percentages were calculated for the variables assessed in this study (i.e., understanding, adherence levels, and motivation to improve PA). Results from the analysis would help the researcher to identify the main factors which may influence PA adherence as well as the potential factors worth noting and taking into consideration in future and strategies to improve teaching and learning with exergames.

RESULTS

After the exclusion of 12 participants (i.e., choosing not to answer the questionnaire, missing questions), participants consisted of 33 pre-service education undergraduate students who participated in this follow-up study.

Participants' Physical Activity Adherence Ratings

Figure 1 below represents the participants' PA adherence ratings. The majority of the participants considered themselves in the "adherence possible" group (N=22, 66.7%). There were five participants (15.2%) scored in the "adherence likely" group while six participants (18.2%) achieved scores in the "adherence unlikely" group.

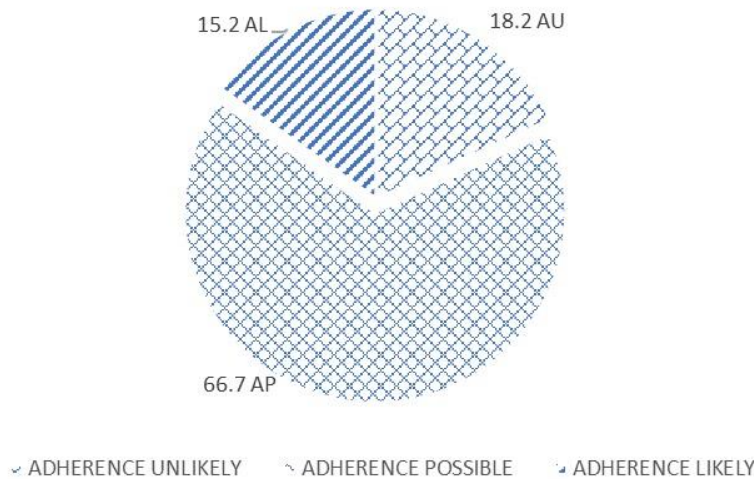


Fig 1. Participants intend to maintain PA with exergame

Specifically, based on Figure 2, item two “I have a strong belief that PA is good for me” recorded the highest mean values (M= 2.91, SD=0.29) in the predisposing factor leading to PA adherence. Nonetheless, item 1 “I am very knowledgeable about exergame and PA” scores the lowest mean in all predisposing factors with (M=2.27, SD=0.57). Then enabling factors found that item 7 “I have a place to do PA near my home or work (e.g., library, campus)” demonstrates the highest mean scores with (M= 2.3, SD= 0.72) while item 5 “I possess good sports skills” the lowest mean in enabling factors with (M= 2.03, SD= 0.72). The reinforcing factors section showed item 11 “I have the support of my lecturers and friends to continue engaging in exergames and PA” scored the highest mean values with (M= 2.55, SD= 0.56) while item 12 “I have a doctor who encourages me to continue doing exergames and PA” recorded the lowest mean scores with (M=1.55, SD= 0.66). Both items 9 and 10 recorded almost similar mean scores with (M=2.42, SD=0.70) and (M= 2.45, SD=0.71) respectively. The graph shows that there has been a steady decline in the number of mean scores across predisposing, enabling, and reinforcing factors of PA adherence. What is striking in this figure is the correlation between knowledge and skills which influence participants’ intention to continue doing PA. For instance, higher knowledge and skills may translate to a higher likelihood of PA adherence and lower knowledge and skills may be manifested into withdrawal or resistance to exergames and PA.

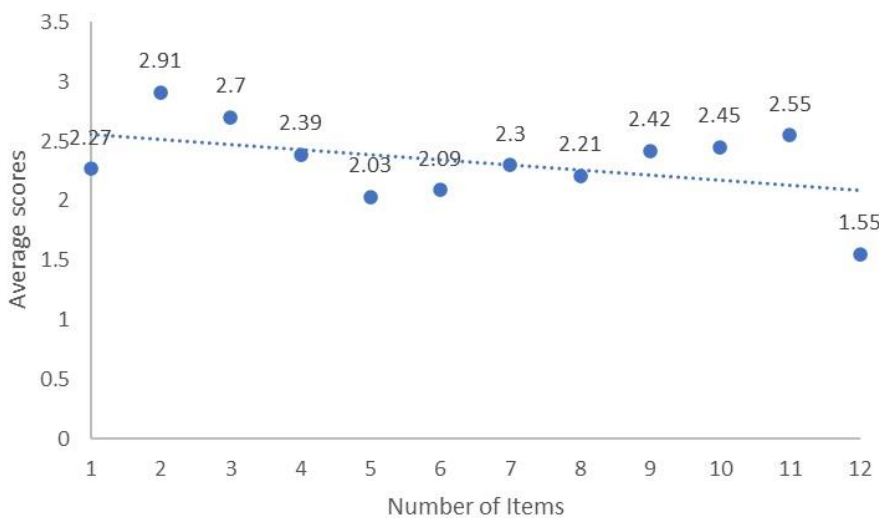


Fig 2. Mean scores across predisposing, enabling, and reinforcing factors of exergames and PA adherence among participants after two years of the initial study (Zulkifli & Danis, 2022).

DISCUSSION

Adherence of PA Through the Exergames Approach

The exergame played a crucial role in promoting PA adherence among participants. Explanation and demonstration provided in the initial study have helped the participants to understand the exergame concept and its potential towards their PA improvement. Additionally, the long intervention during the initial study (i.e., 13 weeks) has provided them with ample opportunity to explore, experiment, play, and reflect on the game (e.g., gameplay, benefits, PA improvement) which strengthens the belief in PA benefits among most participants. Consequently, the majority of the participants considered themselves in the “adherence possible” category. Engaging with the participants to discuss any issues that arise from engaging in exergame can help improve interest in sustaining PA. Learning about skill analysis or statistics from the exergame should be the next focus to help the participants identify their strengths and rectify their weaknesses (Corbin et al., 2009; Wang et al., 2022). Nonetheless, the 18% of participants that fall into “adherence unlikely” might be due to overwhelming new information from the exergame and not sufficient communication between the lecturer and participants (Corbin et al., 2009; Abdelghaffar et al., 2019). Too much information confuses, and a lack of concise instruction hinders the learning process which reduces the internalisation of content.

Besides that, higher mean scores in item 7 of the enabling factor (i.e., a place to do PA at home or work) also demonstrate the advantages of exergame where participants become more independent in deciding on many aspects such as playing time, location, type of activities, action in gameplay which led to a higher sense of ownership, self-esteem, and enjoyment. Participants were not bound with other participants and had a deadline to play and complete missions in the exergame. As individuals are different from others, the freedom offered through exergames provided the impetus for participants to engage in PA at their convenience and less reliance on people and physical education for the opportunity to be active. Reflecting on Sheehan and Katz (2010), the exergame experience provided the participants with an additional sense of control, challenge and constant feedback from the gameplay and analytics (i.e., game statistics). The higher degree of learning ownership in playing an exergame also invokes more curiosity and creativity among participants in many aspects such as calories, gameplay, rewards, and social networking (Staiano et al., 2017).

Accessibility or minimum requirement of equipment also serves as an enabling factor to engage with exergames and PA. Previous studies on children’s PA levels during recess also found that the ability to provide equipment to each student would increase students’ practice time and engagement with the content. In contrast, doing rotations or waiting turns for equipment would reduce students’ skills development and interest in learning the content (Jago & Baranowski, 2004; Verstraete et al., 2006). Similarly in this study, participants suggest that they have the equipment needed to engage in exergames and PA although the initial intervention was conducted during the online distance learning semester at their university. The exergames would normally require only a smart device of any size (e.g., smartphone, tablet, computer tablet), comfortable attires, and a safe environment for them to start playing and engage in various PA movements. This finding was consistent with past studies which suggest that exergames can serve as a good alternative to PA in situations such as bad weather, injuries, and pandemics (i.e., restrict movement) (Corbin et al., 2009; Baranowski, 2016).

Factors Influencing Intention to Maintain Physical Activity

Understanding the factors that influence participants’ intention to engage in PA helps inform our future planning and teaching. Both knowledge and skills in PA demonstrated the lowest mean scores in predisposing and enabling factors respectively. These findings were critical for us to reflect that

participants' intentions would translate into their inclination towards PA preferences. Having sufficient content knowledge about the exergame concept would help shape their intention for PA engagement while possessing the fundamental skills in various PA would also determine their likelihood of maintaining PA for a longer period of time. Past studies have also found that positive experience in sports improves individual adaptability to challenges while reducing negative experiences in the PA adherence process (Lin & Yeh, 2014). Consequently, individuals become more persevering in overcoming obstacles and modify their actions to achieve set goals (Yakun et al., 2020; Wang et al., 2022).

Additionally, self-esteem was an equally important factor that influenced participants' PA adherence. Rose et al. (2017) also highlighted self-esteem as an important fundamental which regulates an individual's cognition, attitude, and emotions which manifest in behavioural attitudes. Results from this study demonstrate consistency (i.e. low mean scores) between items 4, 5, and 6 in the predisposing and enabling factors respectively. The lower mean score in item 4 "I am confident of my abilities in playing exergames and other PA" also resulted in low mean scores in both item 5 "I possess good sports skills" and item 6 "I know how to plan my own PA programme". Similarly, another study with college students found that self-esteem works to improve PA engagement through the generation of positive emotions and strong will (Jun & Han, 2018).

Apart from emotions, higher self-esteem could also be translated into higher belief in dealing with adversity, stronger personal strength and support as well as lower anxiety in dealings with many situations in exergames and PA (Yueqin & Yiqun, 2008). Therefore, self-esteem must be nurtured through a student-centered approach to teaching and learning and a gradual introduction to the exergame knowledge and skills approach as these factors serve as a determinant for individuals adopting lifetime PA. Gradual introduction and continuous assistance from educators can help reduce the reverse effects of exergames and improve the likelihood of lifetime PA among students (Duncan & Staples, 2010).

Besides that, the presence of continuous support and accessibility allows for higher participants' PA adherence. In this study, support from the lecturers was considered the most important followed by friends who shared the same interest and supportive role of family to engage in PA consistently. These findings were similar to other studies with coaches' support on athletes (Gao, 2017), support from physical education teachers and out-of-school sports participation (Hagger et al., 2013), and the chain mediation effect between basic psychological needs, autonomous motivation, and exercise intentions towards exercise promotion (Beihe et al., 2022). The presence of continuous support from stakeholders and accessibility would enhance exergames potential and support longer PA engagement, higher energy expenditure, and the likelihood of lifetime PA participation (McDonough et al., 2018).

The lecturers tend to initiate the exergame, possess knowledge about the concept, and provide participants with the technical skills to start and excel in playing the exergame. Recalled, in the initial study, the researcher spent some time before starting each online class to talk and discuss their exergame progress, skills, and strategies to win levels and missions. Next, friends also played an important role in prompting participants' engagement and maintenance of PA for a longer period of time. Many studies supported the use of a buddy system to perform PA, peer-teaching to improve knowledge and sports skills as well as evaluation of learning (Baranowski et al., 2016; Abdelghaffar et al., 2019). The shift from autocratic towards democratic teaching and learning style help empower the participants, making the PA more relevant to them, and adding value to their daily life. Past studies with adolescents also found that learning sports skills with peers might reduce the number of trials but improve the quality in each trial of the sports skills (Donnelly et al., 2016).

Last but not least, the family was also an important catalyst for participants to explore exergame and engage in lifetime PA. The family provided the participants with a sense of trust, security, and logistics for the

participants to engage in exergame and PA during the online distance learning semester. For instance, in the initial intervention at the participant's home, the parents provided safe areas for engaging in PA in and out of their home, food and beverages to keep them healthy, and a safe place for the participant's protection against weather conditions, viruses (e.g., COVID-19, influenza) and traffic condition. Meanwhile, logistics are related to equipment such as smart devices, appropriate attires, and the Internet to help the participants fully maximise their exergame experience, and complete all its missions through a variety of PA. Supportive families were normally found to be a great determinant of individuals taking up sports and engaging in lifetime PA. In contrast, non-supportive families might lead to lower PA levels and other achievements in their life aspects (Tao et al., 2012; Draper et al., 2015).

Strategies to Achieve PA Adherence

Results from this study highlighted several modifiable factors which can be the starting points for creating strategies to achieve PA adherence, firstly, building knowledge and changing beliefs about exergames and PA. Learning about the exergame purpose, how-to, getting results, and taking action from the results can help the individuals know the truth first-hand and develop their beliefs on credible information. Although knowledge alone does not necessarily change beliefs, the combination of knowledge and awareness of the facts are important determinants towards achieving PA adherence (Corbin et al., 2009). Secondly, performance skills are important to help individuals perform PA safely and successfully. For instance, learning how to use all the features in the exergame such as avatars, battle strategies, selection of equipment, and purchasing items from the marketplace can help participants navigate through the game and strategise their PA to achieve set goals—besides that, refining locomotor movement (e.g., hopping, skipping, running) and non-locomotor movement (e.g., twisting, turning, flexing) through various alternate PA such as aerobic movement, dancing, hiking, running, and climbing can help the individuals to feel more confident which then added enjoyment to the PA (Corbin et al., 2009; Ferkel et al., 2017).

Next, self-monitoring skills help us to monitor our behavioural tendencies and provide eagle-eye views on our behaviour and progress in exergames and PA (Corbin et al., 2009). For instance, learning to understand the statistics section in exergames such as calories, distance covered, number of steps, and time active throughout the day can be extremely useful to provide individuals with tangible information which they can record and track progress on either daily, weekly, or monthly basis. Keeping records should provide us with accurate information on PA engagement which supports lifetime PA. Another important skill to achieve PA adherence will be goal-setting skills. The skill's main purpose is to reflect and establish goals that individuals want to achieve in the future. Realistic goals ensure it is achievable and maintain motivation for a longer time compared to unrealistic goals. Additionally, beginner learners would also best benefit from using these skills to achieve PA adherence (Baranowski, 2016). Specifically, process goals which focus on the process rather than outcomes would be more likely to be useful and realistic for the individual. Ideally, the process goals should be personalised to the individual's current capabilities and needs as well as made visible in all common areas around the individual (e.g., bedroom, study table, locker). For example, a process goal of burning 200 calories from each session of exergame or spending at least 30 minutes with exergame each day is much more effective as it focuses on attainable goals (Corbin et al., 2009).

Furthermore, social support can also be used to achieve PA adherence. Continuous support from educators, family, and friends is important to provide the necessary push for individuals to engage and maintain lifetime PA. Similarly in this study, most of the participants highly rate the influence of lecturers, friends, and family in supporting their engagement in exergames and PA. Another study related to perceived social support on autonomous fitness behaviour among 985 college students also found that perceived social support was capable of positively impacting fitness behaviour, mental toughness, and exercise self-efficacy (Li et al., 2023). Each of the support systems can play a role by encouraging the individual to engage in PA activity, leading by example, and co-developing a schedule or routine that allows for consistent daily

exergame and PA (Beihe et al., 2022). In the advocacy for change, it is not sufficient to only focus on the exergames but rather a call to action for all stakeholders to consider an alternative approach to PA and the learning environment of PE classes (Ferkel et al., 2017).

CONCLUSION

This follow-up study has yielded several important points related to exergames and PA adherence. One of the study's contributions is highlighting the positive relationship between knowledge and skills in which knowledge or skills alone does not translate to a higher likelihood of PA adherence but the combination of both would give the best chances for students to engage and adopt lifetime PA. Additionally, self-esteem was also affected by knowledge and skills which led to proposed chain mediating effects (Beihe et al., 2022; Li et al., 2023). Specifically, possessing knowledge and skills in specific PA would also improve an individual's self-esteem in that context. Additionally, social support from various stakeholders is critical in developing a positive environment that appreciates curiosity and creativity while still providing the students with ownership of their learning process. Providing a positive support system provides the stimulus, motivation, feedback, and reminders for individuals to complete the exergame and achieve PA adherence. A few limitations of this study include a small sample size, a single approach study, and the absence of skills tests. A bigger sample size could be useful in providing clearer information on trends as well as higher generalisability of our results. The addition of skills tests or measurement of energy can help strengthen results gained from the questionnaire and increase the credibility of this empirical study. Therefore, helping the researcher to gain more accurate insights into exergame and PA. Future studies should consider a qualitative approach in addition to quantitative to gain more depth and understanding of the phenomena revolving around exergame and PA. Besides that, having more approaches improves the triangulation process, cross-checked data, and complements results from each approach. Additionally, future studies may consider exploring how the exergame approach can be aligned with the national physical education standard and where could it fit in the current curriculum. Information on this matter can help stakeholders better understand the relevance of the concept and further advocate PA with exergames.

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