Journal of Sustainability Science and Management
Volume 17 Number 12, December 2022: 144-155
eISSN: 2672-7226

DOES EXERGAME HELP IMPROVE PRE-SERVICE TEACHERS' PERCEPTIONS, KNOWLEDGE AND MOTIVATION TO ENGAGE IN PHYSICAL ACTIVITY?

AHMAD FAHIM ZULKIFLI[1] AND AJAU DANIS[2]*

[1]*Faculty of Education, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia.*
[2]*Faculty of Health Sciences, Universiti Teknologi MARA, UiTM Puncak Alam Campus, 42300 Puncak Alam, Selangor, Malaysia.*

**Corresponding author: ajaudanis@uitm.edu.my*
Submitted final draft: 24 August 2022 *Accepted: 30 September 2022* http://doi.org/10.46754/jssm.2022.12.013

Abstract: This study aims to explore participants' insights and feelings towards exergame concepts to promote physical activity (PA). Specifically, aspects such as participants' perceptions, knowledge and motivation towards exergame were analysed to investigate how exergame influences their engagement with PA and learning during online distance learning (ODL). This study adopted a qualitative research design. Both video recording (2 minutes/video) and drawings (i.e., discussed in part two) were utilised to explore the participants' perceptions, knowledge, and motivation with exergame. Convenience sampling was utilised to gather participants who comprised of 45 first-year undergraduate physical and health education (PHE), biology and chemistry major students ages between 20-25 years (i.e., 13 males and 32 females, respectively). The Interpretive Phenomenological Analysis approach was referred to develop the procedures and instruments while Consider.ly software (Usertime Solutions GmbH) was used to analyse data from the videos and drawings. Additionally, the keywords and significant answers were also noted, clustered into main themes to ease understanding and superordinate themes related to this study. Findings indicate that: (i) Exergame concepts were effective in increasing both participants' learning enjoyment and PA level, (ii) The addition of exergame was successful in promoting higher engagement between participants and educators, (iii) A lot of participants reported higher motivation to learn course contents and (iv) Perceived exergame as an opportunity to sharpen their thinking skills through challenges presented in exergame. Overall, the findings contribute to our understanding of how pedagogical strategies such as exergame can be adopted in and out of the classroom to promote desirable learning experiences and academic outcomes.

Keywords: Distance learning, exergame, fitness RPG, learning performance, physical activity.

Introduction

In the year 2022, many of us are now aware of the purpose and benefits of engaging in consistent physical activity (PA) towards: (1) Cognitive, (2) emotional and (3) physical fitness in various age levels and ability groups (Lu *et al*., 2016). Unfortunately, the awareness does not necessarily correlate with desirable action; for instance, Malaysia, a small country in the Southeast Asia region is now the most obese country in the whole of Asia with 7.1% of children under the age of 5 reported as overweight (World Health Organisation (WHO), 2019). Based on the author's engagement with many individuals, factors such as: (1) Boredom, (2) lack of social support and (3) lack of access to equipment and facilities were common excuses for not engaging in PA regularly. Nonetheless, the most critical reason for many individuals not doing sufficient PA consistently is due to the absence of enjoyment in PA. Previous studies also associated enjoyment with the number of participations in PA (DeSmet *et al*., 2014; Baranowski, 2017).

The introduction of smart devices (e.g., phones, tablet, wearable devices) have transformed the way many of us live every day. The smart devices were meant to add

convenience to productivity, learning ideas and as a platform for socialising. Malaysians spend on average 8-9 hours daily with their gadgets for the above purposes [Department of Statistics Malaysia (DoSM), 2019]. In addition, 100% of Internet users aged between 16-64 have utilised social networks or messaging applications as well as spend on average 2 hours and 45 minutes on social media (Kemp, 2020). The ever-increasing academic commitments and social relationships also added up to higher dependence on technology and reduce PA (De Luca *et al*., 2016). In contrast, only 27% of Malaysian aged between 16-64 in the study downloaded applications related to health and fitness (Kemp, 2020).

This study seeks to promote the exergame approach to fill up the void between PA and enjoyment as well as accentuate its potential in the teaching and learning process. Although not necessarily recent, the concept of exergame is lagging compared to other smart devices. The concept tries to combine the element of fun into PA, thus, eliminating boredom while reducing an individual's dependence on peer support as well as specific equipment and facilities to be active. The current COVID-19 pandemic worldwide creates panic, fear of being contagious and reduced freedom of movement among individuals. Prolonged periods of isolation and lack of face-to-face meetings reduce skills development, the linkage between concepts learnt online with real situations, and anxiety among individuals (Varea & Gonzalez-Calvo, 2020). The current situation has also intensified the need to promote tools available to encourage an individual to be more physically active and independent learners.

In general, exergame encourages players to engage in PA to complete the task or mission. Thus, helping them to increase PA levels and engagement with lifetime PA (Baranowski, 2017). Previous studies found that exergame contributes to healthier individuals and has a positive influence on cognitive, affective and psychomotor domains (e.g., ideas to get active, enhance self-efficacy, higher accumulation of PA) (Baranowski *et al*., 2008; DeSmet *et al*., 2014). Importantly, as most young adults in Malaysia attended learning institutions; colleges and universities would provide an ideal platform to promote PA participation through technology (DoSM, 2019).

Exergames as a Tool to Promote PA and Teaching Physical Education (PE)

The previous meta-analysis of 35 studies on health and exergame between children and adolescents demonstrated exergame capabilities to increase METs and PA when compared to sedentary video gameplay (Gao *et al*., 2015; Gao *et al*., 2017). The overall improvement in individuals' PA levels was also attributed to the motivating and entertaining nature of exergame (Gao & Chen, 2014). Moreover, the adoption of exergame was seen as a welcoming distraction as it helped to reduce rating perceived exertion (RPE) during moderate-to-vigorous intensity (MVPA) PA (Gao *et al*., 2017; Gao, 2017). Therefore, many of the participants were able to engage in longer PA per session and increase the likelihood of lifelong PA (McDonough *et al*., 2018). Nonetheless, it is worth mentioning the nature of the game would also influence the heart rate (HR) and the amount of energy expenditure (EE) throughout playing the game (McDonough *et al*., 2018).

Beyond the physical aspect, the exergame approach would also positively influence an individual's self-efficacy when doing PA which is critical for lifelong PA adoption (DeSmet *et al*., 2014). The element of fun and relevancy of the game was also important to encourage the individual to shift or add from routine PA (e.g., traditional PA) to a more exciting PA session (e.g., technology-assisted PA) (Verheijden Klompstra *et al*., 2014). The element of entertainment, narrative and engagement in the game helps enhance its appeal and effectiveness while distracting the individual from the intimidating number of repetitions, intensity and types of training (Lu *et al*., 2012; Lyons *et al*., 2016).

Additionally, the game presents them with the onus to plan, perform and evaluate their PA performance (e.g., calories, distance, mission, character levels). Individuals being able to decide their PA and time to perform helped increase motivation levels and as well as brought a sense of enjoyment, reduce pressure and more independence for the opportunity to be active (Mellecker *et al*., 2013). Cautiously, the element of fun is still very subjective and may be interpreted differently across age, gender and ability groups (Lu *et al*., 2016). Moreover, the type of stories and the choice of narrative integrated into the game or offered in parallel most preferred by different ages, gender and populations would also present future research opportunities in this area (Lu *et al*., 2016).

Many researchers have explored the exergame approach on different populations throughout the years. For instance, a systematic review of exergame effects on the rehabilitation of seniors found that most of the studies yielded some if not most positive outcomes, particularly on the balance aspect (Zeng *et al*., 2017). Comparison studies on exergame between children with autism spectrum disorder (ASD) and children without ASD in six exergame sessions of 45 minutes over two weeks have found no difference in object control skills. The authors were unsure if the insufficient amount of gameplay or lack of supervision has led to the results. Fortunately, all the participants showed interest in playing the game which encourages more work to be done to adopt this concept effectively (Edwards *et al*., 2017).

Another study of dance exergaming with 37 adolescent girls three times per week over 12 weeks under supervision demonstrated positive psychosocial outcomes (i.e., self-reported intrinsic motivation, self-efficacy, PA). Nonetheless, no significant impact was observed on objectively assessed PA behaviour and leisure physical activity (LPA) improved as compared to moderate-vigorous physical activity (MVPA) (Staiano *et al.,* 2017). Weaknesses in methodology and reporting of previous studies have hindered firm conclusions and warrant more studies in this area (Baranowski, 2017).

Introduction to Fitness RPG (Shikudo Inc.)

For this study's purposes, the author introduced the Fitness RPG (Shikudo Inc.) game to participants at the beginning of the study. The game revolves around several avatars (called heroes) in their quest through Fitland to the Fit Castle. Throughout their journey, the heroes would encounter many types of different strengths and weaknesses monsters. Apart from regular role-playing game (RPG) features (e.g., collecting things, customising heroes, improving heroes' levels through battles), the game also encourages players to engage with PA and achieve 10,000 steps daily to unlock rewards as well as converting those steps into energy needed to train heroes, upgrade and purchase equipment in the game. Game data can be synced between smart devices and is accessible anywhere via the player's account. Additionally, the players can also compete and interact with other players in the game arena via the Internet.

Therefore, the main aim of this study was to explore participants' current insights and feelings toward the exergame. Additionally, the author will also discuss the exergame roles to motivate higher engagement in PA and promote teaching and learning through participants' drawings perspectives. The findings of this study would inform future intervention studies among different populations as well as advocate for the use of technology to promote learning through movement in and out of the classroom as well as lifelong PA. Furthermore, this study would also recommend additional tools to enhance the game's effectiveness and support individuals' engagement with PA.

The primary objectives of this research include: (1) To explore participants' perceptions towards Fitness RPG and exergame approach, (2) To investigate participants' knowledge gained from playing the Fitness RPG game (i.e., advantages, disadvantages, future improvement, game as a teaching tool) and (3) To investigate participants' motivation to adopt the exergame approach during online distance learning (ODL) and the COVID-19 pandemic.

Materials and Methods

Participants

Adopting the convenience sampling technique, the participants were recruited via students' enrolment in the individual sports subject between October-February 2021 from three departments (i.e., physical education (PE), biology, chemistry) of the Faculty of Education in a local university located in central of Selangor, Malaysia. All participants were aged between 20-25 years old and were currently undergoing pre-service teachers training and would receive a degree in education after completing their four-year program at the university. As many as 45 first-year education students (13 males and 32 females; 11% (5) from East Malaysia and 88% (40) West Malaysia students) participated in the study. Contents of the subject and assignment (e.g., rubrics, time, goals) were consistent throughout each class (e.g., physical education, biology, chemistry) and the intervention was conducted from October-February 2021.

Settings

All interventions were conducted at the participants' preferred time and hometown due to the movement control order (MCO) set by the Malaysian authorities. Due to the movement restriction majority of teaching and learning throughout the semester was conducted via online distance learning (ODL). All materials (e.g., link to download the exergame, guidelines, rubrics and examples of videos) were shared with the participants before the beginning of the study. The researcher invested considerable time in learning, discussing and playing the game himself before the study was conducted to ensure the researcher gained initial insights into the exergame and could troubleshoot any issues that may arise throughout the data collection process.

Procedures

This study adopted the phenomenological approach as the basis of this study. This qualitative approach allowed the researcher to attempt to describe the phenomena from all the participants' perspectives. Specifically, this study seeks to understand how participants perceive the Fitness RPG, the game's roles in shaping an individual's experience towards PA (Neubauer *et al*., 2019) and to explore meanings that inform or readjust our understanding of the exergame concept and application among participants (Gill, 2014). Additionally, adopting this approach helped us to expand our understanding of learning, behaviours and communication stemming from the exergame approach in learning.

Lower students' engagement in physical activity beyond class sessions and ODL throughout the semester become the basis of this study. The researcher spent two months before the beginning of the new semester devising the study design which included the period of literature review to gain insights into the exergame approach, meeting experts (online) to discuss appropriate aims, objectives and methodological issues of this study. The next phase involved researchers engaging the students to inform them about the study framework, benefits and potential risks associated with participation in this study. Once the students fully understood and all questions were satisfied, the participants were invited to complete the consent form. Importantly, any outcomes from this study would not affect nor changed while evaluating the marks they would receive at the end of the semester. Additionally, the participants were free to withdraw from the study at any time without any consequences. Ethical approval (REC/11/2021 MR/846) was obtained from the university research ethics committee before the beginning of this study.

The participants were introduced to the Fitness RPG (Shikudo Inc.) game as part of their assignment for the individual sports subject. Apart from the game, the author also highlighted the rubrics and goals of completing this task. There were no specific instructions on what, when, where, whom and how they should collect the steps to convert energy and win missions. Prompts such as reminders and ideas of

activities (e.g., jogging, doing house chores) and occasional checks on the participants' progress helped the participants to keep motivated and continue doing PA throughout the study. At the beginning of each class (i.e., ODL) during the first month of the semester, the researcher would take time to answer any questions and address issues raised by those playing the game. Participants were also encouraged and reminded about the benefits of regular PA and their continuous assessment throughout the study.

Data was collected between weeks 13-14 of the semester which involved participants completing two drawings and a video reflection of participants based on the five questions shared by the researcher. Findings based on drawings will be shared in the second part of the study. Apart from the drawings, the participants were also required to reflect on their experience with Fitness RPG for a maximum of five minutes through video recordings via the Flipgrid application (Microsoft Inc.). Five questions were used as the basis for the participants to reflect on their experience, there were no specific correct and wrong answers to any of the questions and completion of the videos, instead, they were encouraged to reflect on the process based on their personal experience.

Occasionally, the researcher would remind the participants about their rights while participating in this study. All identities would remain anonymous, and data related to this study would be treated with high confidentiality and used only for this study. Participants who did not complete any of the instruments or opted to withdraw were excluded from this study. The final phase involved the researcher conducting thematic content analysis separately; both drawings and videos were viewed, reviewed, transcribed, compared individual analyses, discuss disagreements and look for conformity regarding meaningful themes and sub-topics. Themes deemed to have a minor contribution to the understanding of this study were rejected to ensure only meaningful data was discussed throughout this study.

Instruments

Semi-structured Interview

The semi-structured interviews were important to explore the in-depth meaning of the participant's thoughts and feelings towards the Fitness RPG game. The interviews were modified to video recording via Flipgrid (Microsoft Inc.) due to the MCO and ODL implemented throughout the university. The questions comprised of five open-ended questions aimed to prompt participants to describe their experiences and how the game may influence their future lifestyles. The questions were cross-checked by the author and sent for peer-reviewed by experts in the field of studies.

Specifically, questions such as: (1) What is your feeling while playing the game?, (2) What are the advantages of playing the game?, (3) What would be the disadvantages of playing the game, (4) How do you think exergame can help you to improve your teaching skills in future? and (5) How do you rate your motivation levels to play fitness RPG throughout this semester and why? For question five, the participants were required to rate their motivation levels on a scale of 1-5 (i.e., 1 – least motivation and 5 – highest motivation) and provide reasons for their answers in the videos. Again, the researchers emphasised subjectivity and encouraged the participants to reflect on their feelings and experiences while playing the game.

Data Analysis

Data analysis included 45 participants who enrolled in the course for individual sports during their second semester. Participants who did not consent or missed either drawings or the reflection videos were excluded from this study (n=5). The Interpretive Phenomenological Analysis was adopted in this study to explore participants' perceptions and meanings between the Fitness RPG, their lives and the future teaching profession (Nagamey *et al*., 2018).

The reflection videos were reviewed a minimum of two times to allow the researcher to be familiar with the video's contents. Keywords

and significant answers from the videos were noted to create a preliminary list of initial categories. The second list was created from connecting keywords and clustered into three mains themed with sub-topics. A table was created to ease the understanding of ideas and produce superordinate themes related to this study (Nagamey *et al*., 2018). Importantly, both drawings and videos were compared, identified disagreements and looked for conformity between themes to ensure meaningful data interpretation.

Results and Discussion

The analysis of the videos was conducted using Consider.ly (Usertime Solutions GmbH) to identify the main themes and subthemes based on tags created from the videos. Consequently, the data analysis yielded two main themes. The first theme described issues related to teaching and learning through the game which comprised subthemes of PA with technology, engagement with instructors and lesson content as well as learning enjoyment. The second theme revolved around the benefits of playing Fitness RPG which includes subthemes such as motivation to be better and critical thinking (for a summary of the interviews' themes and subthemes, see Table 1).

Teaching and Learning through Games

Physical Activity with Technology

The participants of this study showed that they were more than willing to learn content while using technology and even embracing the potential of technology to help achieve their goals and objectives. Most participants viewed Fitness RPG positively as it promotes PA through games while reducing perceived exertion, peer-pressure as well as fear of failure throughout each session. "Fitness RPG helped me to exercise more than I did before" (Fik), "I am exercising more this semester both during and beyond PA class" (Riz), "I think many people will like playing this game as it fun and trendy among the younger generation" (Mirz).

Additionally, exergame provides participants with more options to keep active and healthy: "I like this game as it helps me to track my daily steps and self-monitor my progress on daily basis" (Redzm), "This game helps me to focus and set targets in learning" (Amr) while "I feel happy to be able to do different types of PA and I am not restricted to a specific PA when playing this game" (Farah). Another participant also suggested: "I believe this game is a healthier choice of e-sport as it is challenging and can be played by most people" (Tasha).

Therefore, the addition of Fitness RPG provides additional value to participants' learning through the combination of PA and game, learning tools, freedom of PA as well as teaching content based on participants' interests. The Fitness RPG provided more options for participants to enjoy doing their preferred PA compared to more specific exergaming such as the Nintendo Switch (Nintendo Inc.) which players engaged in a specific movement to complete the mission. This was echoed by

Table 1: Verbal themes and subthemes from video reflections

Video Reflections	
Themes	**Subthemes**
1. Teaching and learning through game	1.1 PA with technology 1.2 Engagement with instructors and lesson contents 1.3 Learning enjoyment
2. Benefits of playing Fitness RPG	2.1 Motivation to be better 2.2 Critical thinking

previous authors who suggested exergame can be more effective when the students were provided with options and freedom to engage with PA rather than restricted to specific training (McDonough *et al*., 2018).

Nonetheless, several participants voiced their concerns about connectivity and the cost involved in playing Fitness RPG. For instance, "Sometimes I was not able to play the game as I did not have access to the Internet (i.e., not synching)" (Zair) and "The game is highly dependent on Wi-Fi, without it, the game consumes too much data and we need to spend money to purchase additional Internet data" (Nasr). Besides that, a few participants voiced concerns about learning assessment through exergame: "I think this game is not suitable for assessment and it is unfair for people who have various smartphones and Internet connection issues to complete this assignment" (Leen) while "My smartphone was damage earlier and when I changed to another device, the data was lost or did not synch" (Afiq). Another participant suggested: "I think many students will tend to always play this game and do less revision or other assignments" (Ikram).

As the participants come from diverse backgrounds throughout Malaysia and have ODL throughout the semester, it was expected some of the participants would have problems playing and completing the assignment in the best manner. This was demonstrated when some participants managed to complete challenges and reached the Fit Castle (i.e., the final mission) while others barely finished half the missions. The author approached the participants with issues and provided personalised teaching (i.e., strategies to complete mission, relationship between learning contents and game), adjusted their goals (i.e., modified assignment rubrics) as well as provided occasional feedback on their efforts in playing the game. Additionally, parental support was equally important to promote PA engagement during and beyond class sessions (Rose *et al*., 2017).

Engagement with Instructors and Lesson Contents

The addition of Fitness RPG into learning content promotes higher engagement between instructors and students. Through the game, participants were seen to try harder and be more willing to ask questions about steps daily, gameplay, equipment and goals to achieve the mission. For instance, the participant (Mary) suggested "I prefer to ask the lecturer for any questions rather than looking solely on the Internet because I think I can get more personalised answer to my questions" while "I often refer to my friends and lecturer on strategies to win mission" (Nur). Besides that, "Although I am not a gamer, the lecturer's explanation early in the semester and checking updates from students helped me to continue playing the game" (Idah).

Most of the participants provided positive reflections in terms of the game and engagement between both instructors and their peers. Multi-players feature in the game also contributed to higher engagement as participants could challenge each other in battle and communicate on matters related to the game. Nonetheless, one participant was concerned about the instructor's knowledge and experience with the game which could affect the effectiveness of the exergame concept in the classroom.

For example, "Although exergame is a good alternative to teaching, the teacher must have prior knowledge and experience of the game. Otherwise, students will have difficulty in playing and relating the game to the learning contents" (Izz). Apart from content knowledge, few participants also mentioned the importance of role models, which in this context, participants were expecting the instructor to experience the process of playing Fitness RPG. One participant suggested: "I think the lecturer should lead by example and share his progress occasionally in class to inspire students to try their best and complete all missions" (Dian). While "I think if the lecturer plays the game, he would be able to explain to me the function of pets rather than directing the students to the Internet for answers" (Mirulafan).

Based on the participants' answers, the instructor's roles were still important albeit now leaning towards facilitating rather than dictating students' learning. Exergame provides a good learning tool rather than replacing the instructor's role in the delivery of learning content. This was also reflected by previous studies that suggested simply providing exergame would not increase an individual's PA levels and the exergame serves as a supporting role to support learning and PA (Baranowski, 2017). Additionally, another study found that dance exergaming three sessions/week over 12 weeks among 37 adolescent girls yielded higher self-reported intrinsic motivation, self-efficacy and leisure PA but no effects on moderate-vigorous PA assessed in their study (Staiano *et al*., 2017). Therefore, teaching and learning with the guided use of technology approach would be the best to intrigue, stimulate and maintain students' interest in learning with technology.

Learning Enjoyment

Majority of participants in this study tend to relate Fitness RPG with higher learning enjoyment throughout the semester. As this was the first time, they experienced exergame, some participants were curious and excited while others were hesitant and felt stressed due to exergame. One participant suggested: "I think this game is unique which led to higher excitement, curiosity and covered all learning domains (e.g., cognitive, affective, psychomotor)" (Dia). Another participant added: "This game helped me to become more active, focus, set targets in learning, it was nice to have a small competition between my friends" (Leen). Additionally, "I love the imagination and strategies involved in winning this game as I think it helps sharpen my mind and reduces stress too" (Nisa).

This study demonstrated the addition of exergame was capable of shifting participants' perception toward learning and PA as well as developing more independent learners. They were more willing to learn, ask questions, be creative, solve problems (e.g., winning a mission) and persevere when adding exergame as part of their assignment. The participants' feeling was coordinated with the previous study's findings that young adults were more willing to participate in an activity that provided them with choice, novelty, mentorship, rewards, competition and flexibility (Corder *et al*., 2015).

Previous authors suggested individuals were more driven and willing to accept if they viewed the experience as personally relevant, challenging and fun. Additionally, the fun factor was also crucial in developing mental strength, patience and persistence to succeed in exercise as well as other aspects of life (Ferkel *et al*., 2017). Nonetheless, it was critical to remember what fun constitutes may vary across age, gender, and ability groups. Additionally, relying solely on exergame has shown improvements in PA but it is not better than regular physical education or after-school programs (Baranowski, 2017). Therefore, although Fitness RPG was capable to shift participants' perception toward PA, additional activities and learning tools were needed to improve participants' PA levels. The game serves as an initial bait to engage with PA whereas the instructor's teaching and activities would help participants' sustained PA.

Benefits of Playing Fitness RPG

Motivation to be Better

The addition of Fitness RPG into regular learning sessions has positively motivated participants to learn about the game as well as other content in the course. As many as 25 (56%) and 6 (13%) of the participants rated "high" and "very high" motivation levels, respectively to engage with Fitness RPG. Most of the participants shared the feeling of novelty, achieving personal goals and becoming more independent in doing PA. For instance: "I was never active before this class; it is because of Fitness RPG that I have started exercising almost every day now and I feel proud of myself" (Asm). Additionally, "I feel that with the game, I am now less reliant on my friends to go out and exercise" (Zai). Another participant pointed to curiosity which spurred him to complete as many missions as possible

in the game: "This is my first time playing this kind of game, so, I was a little curious" (Man).

Personal goals such as losing body weight, reducing stress due to academic commitment and avoiding time wastage were also shared by many participants in the videos. The participants suggested: "Apart from getting marks from this assignment, I can lose some body weight which helps me to feel energetic and healthier throughout this semester" (Zai). "I feel very happy because this game helped me to reduce some stress during online distance learning (ODL) and completing other assignments" (Nas). Besides that, some participants also highlighted their personal goals to overcome challenges, missions and monsters present in the game. For instance, "I am motivated to achieve 10 K steps daily to open the treasure chest (i.e., reward) in the game" (Tasha), "I felt really satisfied to defeat the enemies" (Ame) and "I particularly like to collect the pets as one of the pets looks like my favourite cartoon character" (Mirz).

The addition of the game to the exercise gave added value and excitement to PA. This was supported by Gao and Chen (2014) who suggested entertainment values in the exergame provide additional attraction among individuals to engage in PA. Moreover, the participants demonstrated that exergame to allowed them to achieve personal goals (e.g., start/consistent doing PA, 10 K steps daily) whereas without the game, the personal goals might look impossible and unreachable. Therefore, exergame helped participants positively shift their perceptions toward PA and focus on achieving goals rather than feeling forced into doing PA daily. Previous studies also perceived exergame as a welcoming distraction to their studies where participants reduce RPE during MVPA (Gao *et al*., 2017; Gao, 2017).

Critical Thinking

Critical thinking is a valuable skill needed by individuals to engage and solve many issues throughout their lives. Fitness RPG game presents the participants with a series of increasingly difficult challenges that required the players to upgrade their character attributes through PA, battle monsters and purchase energy from its marketplace. Additionally, the participants must strategise in terms of avatars, skill and magic selection to win battle and progress to the next mission.

The participants expressed mixed feelings about this subtheme: "I think it is very difficult to progress to the next mission, especially from mission four onwards" (Kina) and "Sometimes I feel angry due to the amount of energy needed (i.e., upgrade avatar) to progress to next mission" (Irah). Meanwhile, some participants embrace the challenges and went on to reach the Fit Castle (i.e., final mission): "You need to choose avatars which possess different strengths, so, they complement each other and win the battle" (Tira) and "I decided to upgrade strength attribute the most compared to others as I think it will damage the enemies the most" (Mary).

Although cognitive capabilities were not assessed in this study, the authors speculate due to the nature and difficulty of the exergame, the participants can experience an increase in cognitive functions and perform better academically. The participants were consistently required to collect steps through PA to convert into energy; the more steps, the more energy can be used to upgrade avatars and purchase equipment in its marketplace. A previous study on the effects on brain functions found that PA conditions with high levels of cognitive engagement would yield higher brain functions compared to PA with low cognitive engagement. Both acute and long-term PA with cognitive engagement would significantly boost brain functions compared to similar-intensity PA but with lower cognitive engagement (Schmidt *et al*., 2016). Other studies also supported the beneficial effects of PA on cognitive performance in various populations (Verburgh *et al*., 2014; Donnelly *et al*., 2016).

Implication for Practice

The study's findings would help more students to utilise their interest in-game to engage in more variety of PA. Students can be given the liberty to decide what type of PA they are interested in, when they wanted to participate and where they wish to engage in PA. Higher learning ownership among students would also translate into higher self-efficacy, motivation, and enjoyment in the learning process (Staiano *et al*., 2017). The learning ownership is given also provided the opportunity for students to choose the intensity and frequency of PA, thus, they would be more willing to participate while reducing peer pressure and fear of failure.

Apart from the physical aspect, students can be encouraged to engage with their peers, develop strategies and customise their avatars to win and progress through each mission. Therefore, playing the game also helps the students to develop added values such as creativity, perseverance and problem-solving. Although the results have been mixed (i.e., effective against non-effective), majority of studies have associated exergame with positive outcomes for the individual, particularly with students facing barriers to PA (e.g., religion, culture, lack of equipment and facilities) (Baranowski, 2017).

There were several strengths and limitations of the study. This study has addressed limitations in the previous studies with a longer period of playing time (14 weeks) compared to single trials (McDonough *et al*., 2018) and higher generalisability due to the involvement of mixed-genders participants from different fields (e.g., PE, biology, chemistry) compared to gender-exclusive and small sample size in other studies (Staiano *et al*., 2017). Nonetheless, some limitations include the absence of face-to-face focus group discussion due to the COVID-19 pandemic which may cause misinformation or interpretation of participants' reflections of their experience. Another limitation is the participants' use of various capabilities smart devices when playing Fitness RPG which may affect consistency in PA records and personal experience throughout the intervention.

Conclusion

Exergaming for 14 weeks among undergraduate pre-service education teachers was associated with positive impact on participants' knowledge, motivation and perception of the game as a learning tool. Evidence for transfer effects on PA was limited due to participants' self-reported data and absence on campus during data collection (i.e., online distance learning). Nonetheless, the author was confident with exergaming as a medium to promote learning, develop individual positive values and classroom management. Future studies should consider investigating the potential consequences of prolonged exposure and engagement with exergame from various aspects such as healthcare (e.g., eye irritation, headache), addiction to exergame as well as the financial implication of participating in exergame.

Acknowledgements

The main author wishes to express gratitude to Dr. Ajau Danis (Faculty of Health Sciences) and the Faculty of Education, UiTM for their support, including their time, advice and logistical support in helping to ensure this study was completed.

References

Baranowski, T. (2017). Exergaming: Hope for future physical activity? or blight on mankind? *Journal of Sport and Health Science, 6*, 44-46.

Baranowski, T., Buday, R., Thompson, D. I., & Baranowski, J. (2008). Playing for real: Video games and stories for health-related behaviour change. *American Journal of Preventive Medicine, 34*(1), 74-82.

Corder, K., Schiff, A., Kesten, J. M., & van Slujis, E. M. (2015). Development of a universal approach to increase physical activity among adolescents: The GoActive

intervention. *British Medical Journal Open, 5*(8), 1-12.

De Luca, S. M., Franklin, C., Yueqi, Y., Johnson, S., & Brownson, C. (2016). The relationship between suicide ideation, behavioural health, and college academic performance. *Community Mental Health Journal, 52*, 534-540.

Department of Statistics Malaysia. (2019). *ICT use and access by individuals and households survey report 2019 [Press Release]*. https://www.dosm.gov.my/v1/index.php?r=column/pdfPrev&id=SFRacTRUMEVRUFo1Ulc4Y1JlLzBqUT09

DeSmet, A., Van Ryckeghem, D., Compernolle, S., Baranowski, T., Thompson, D., & Crombez, G. (2014). A meta-analysis of serious digital games for healthy lifestyle promotion. *Preventive Medicine, 69*, 95-107.

Donnelly, J. E., Hillman, C. H., Castelli, D., Etnier, J. L., Lee, S., & Tomporowski, P. (2016). Physical activity, fitness, cognitive function, and academic achievement in children. *Medicine & Science in Sports & Exercise, 48*, 1197-1222.

Edwards, J., Jeffrey, S., May, T., Rinehart, N. J., & Barnett, L. M. (2017). Does playing a sports active video game improve object control skills of children with autism spectrum disorder? *Journal of Sport Health Science, 6*, 17-24.

Ferkel, R. C., Razon, S., Judge, L. W., & True, L. (2017). Beyond "fun": The real need for physical education. *The Physical Educator, 74*, 255-268.

Gao, Z. (2017). Fight fire with fire? Promoting physical activity and health through active video games. *Journal of Sport and Health Science, 6*(1), 1-3.

Gao, Z., & Chen, S. (2014). Are field-based exergames useful in preventing childhood obesity? A systematic review. *Obesity Review, 15*(8), 676-691.

Gao, Z., Chen, S., Pasco, D., & Pope, Z. (2015). A meta-analysis of active video games on health outcomes among children and adolescents. *Obesity Review, 16*, 783-794.

Gao, Z., Pope, Z., Lee, J. E., Stodden, D., Roncesvalles, N., Pasco, D., Huang, C. C., & Feng, D. (2017). Impact of exergaming on young children's school day energy expenditure and moderate-to-vigorous physical activity levels. *Journal of Sport and Health Science, 6*, 11-16.

Gill, M. J. (2014). The possibilities of phenomenology for organizational research. *Organ Research Methods, 17*, 118-137.

Kemp, S. (2020). *Digital 2020: Malaysia.* Retrieved from https://datareportal.com/reports/digital-2020-malaysia

Lu, A. S., Baranowski, T., Thompson, D., & Buday, R. (2012). Story immersion of video games for youth health promotion: A review of the literature. *Games Health Journal, 1*, 199-204.

Lu, A. S., Buday, R., Thompson, D., & Baranowski, T. (2016). What type of narrative do children prefer inactive video games? An exploratory study of cognitive and emotional responses. In Tettegah, S. Y., & Huang, W. D. (Eds.), *Emotions, Technology, and Digital Games*. London. Academic Press.

Lyons, E. J., Baranowski, T., Besen-Engquist, K. M., Lewis, Z. H., Swartz, M. C., Jennings, K., & Volpi, E. (2016). Testing the effects of narrative and play on physical activity among breast cancer survivors using mobile apps: Study protocol for a randomised controlled trial. *BMC Cancer, 16*(202), 1-18.

McDonough, D. J., Pope, Z. C., Zeng, N., Lee, J. E., & Gao, Z. (2018). Comparison of college students' energy expenditure, physical activity, and enjoyment during exergaming and traditional exercise. *Journal of Clinical Medicine, 7*(11), 1-10.

Mellecker, R., Lyons, E. J., & Baranowski, T. (2013). Disentangling fun and enjoyment in exergames using an expanded design, play, experience framework: A narrative review. *Games Health Journal, 2*, 142-149.

Nagamey, N. M., Goldner, L., & Lev-Wiesel, R. (2018). Perspectives on social suffering in interviews and drawings of Palestinian adults crossing the Qalandia checkpoint: A qualitative phenomenological study. *Frontiers in Psychology, 9*, 1-13.

Neubauer, B. E., Witkop, C. T., & Varpio, L. (2019). How phenomenology can help us learn from the experiences of others. *Perspectives on Medical Education, 8*, 90-97.

Rose, T., Barker, M., Maria, J. C., Morrison, L., Lawrence, W., & Strommer, S. (2017). A systematic review of digital interventions for improving the diet and physical activity behaviours of adolescents. *Journal of Adolescent Health, 61*(6), 669-677.

Schmidt, M., Benzing, V., & Kamer, M. (2016). Classroom-based physical activity breaks and children's attention: Cognitive engagement works! *Frontiers in Psychology, 7*, 1-13.

Staiano, A. E., Beyl, R. A., Hsia, D. S., Katzmarzyk, P. T., & Newton Jr, R. L. (2017). Twelve weeks of dance exergaming in overweight and obese adolescent girls: Transfer effects on physical activity, screen-time, and self-efficacy. *Journal of Sport and Health Science, 6*, 4-10.

Varea, V., & Gonzalez-Calvo, G. (2020). Touchless classes and absent bodies: Teaching physical education in times of COVID-19. *Sport, Education and Society,* 1-15.

Verburgh, L., Konigs, M., Scherder, E. J. A., & Oosterlaan, J. (2014). Physical exercise and executive functions in preadolescent children, adolescents, and young adults: A meta-analysis. *British Journal of Sports Medicine, 48*, 973-979.

Verheijden Klompstra, L., Jaarsma, T., & Stromberg, A. (2014). Exergaming in older adults: A scoping review and implementation potential for patients with heart failure. *European Journal of Cardiovascular Nursing, 13*(5), 388-398.

World Health Organisation. (2019). *Sugary drink tax important first step, but obesity in Malaysia demands further action.* https://www.who.int/malaysia/news/commentaries/detail/sugary-drinks-tax-important-first-step-but-obesity-in-malaysia-demands-further-action

Zeng, N., Pope, Z., Lee, J. E., & Gao, Z. (2017). A systematic review of an active video game on rehabilitative outcomes among older patients. *Journal of Sport Health Science, 6*, 33-43.