EXERGAMING IMPROVES SELF-EFFICACY IN SUSTAINING PHYSICAL ACTIVITY AMONG SEDENTARY UNIVERSITY STUDENTS

Hafzan Yusoff*, Wan Nudri Wan Daud, and Ahmad Syahmi Rasyad

Nutrition and Dietetic Programme, School of Health Sciences
Universiti Sains Malaysia

*Email: hafzany@usm.my
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Abstract

This research contrasts the physical activity-related self-efficacy before and after exergame play and the gender-wise expectancy related to beliefs and task values. Sedentary undergraduates (n=102; 51 males, 51 females) were recruited from a local university in Kota Bharu, Kelantan using Global Physical Activity Questionnaire (GPAQ). Participants completed questionnaires assessing their self-efficacy, expectancy related beliefs, subjective task values and intention to participate in exergame play in the future. After exergame play, participants had a significantly higher degree of self-efficacy than before exergame play (mean score: before 27.1 ± 4.33 vs. after 32.2 ± 4.51; $p < 0.001$). Their belief in their ability to exercise on a regular basis varied considerably across gender, with higher values reported in male than in female participants (mean difference= 0.84, p=0.02). Other components, such as expectancy-related beliefs, task values, and intentions, were comparable between gender. Besides, participants also considered exergaming to be more attractive and stimulating than traditional physical exercise, thereby presenting greater beliefs in capability and greater desire to engage in exergaming in the future. The result suggests that exergame play can be used as an innovative approach to increase the level of physical activity among sedentary university students.

Keywords: Exergame, self-efficacy, physical activity

Introduction

Recent data from the National Health and Morbidity Survey showed that 1 in 4 adults Malaysian is physically inactive (Institute for Public Health, 2020). Despite the fact that regular physical activity prevents the development of chronic diseases, majority of Malaysian adults were living a sedentary lifestyle, and 1 in 2 of them are obese (Institute for Public Health, 2020). Young adults are not as active as they should be (Alzamil et al., 2019) and the determinants that contribute to this condition must, therefore, be understood.

It is worrying that Malaysia has also recently been identified as one of the least physically active countries in the world, with more than 60 per cent of adults sedentary and half of the adult population affected by obesity (Institute for Public Health, 2020). However, for many Malaysians, physical exercise is simply not seen as an attractive way to spend their time. Furthermore, up to 80 percent of children and adolescents in this country failed to achieve the minimum recommendation for daily physical activity (Lamboglia et al. 2013). Combined with poor eating habits, being inactive has built a society where rates of obesity and non-communicable diseases are rising at alarming rates. Previous studies have indicated a perceived lack of access to suitable facilities such as parks and playgrounds, safety issues, and low self-efficacy as obstacles to physical activity participation (Allison et al., 1999).

Exergame is a new generation of exercise. It is defined as the activity of playing video games that involve physical exertion and are thought of as a form of exercise. An example of a well-known exergame is Nintendo's Wii Fit. It was suggested that exergame is a promising tool to motivate and engage users in physical activity. Not many studies have been carried out to clearly demonstrate the potential of exergame, especially in relation to self-efficacy, which is one of the most significant determinants of physical activity. Therefore, this study was carried out to investigate whether exergame has the potential to increase the self-efficacy of adults in practising physical activity.

Theoretical Perspectives

Self-efficacy theory

The theory of self-efficacy is at the heart of Bandura's social cognitive theory, which emphasizes the role of observational learning and social experience in the development of personality (Bandura, 2009). In the field of exercise and physical activity, self-efficacy has been established as both a determinant and a consequence of participation in physical activity (Vernadakis et al., 2014). Self-efficiency is a powerful influence on the motivation, achievement and self-regulation of individuals. The higher the self-efficacy of a person, the greater their motivation, persistence and performance they would have experienced than those with lower self-efficacy (Gao et al., 2008).

The technological advances of the 21st century and the improper use of electronic media had become a major contributor to the growing problem of inactivity. It is, therefore, appropriate to explore the potential of exergame in improving physical activity, especially among children, adolescents and younger adults. Implementation of exergame would provide an opportunity to deliver health messages, motivate and guide people to make a healthy lifestyle change. Furthermore, video gaming has become even more popular in our society.

According to Weibell (2011), self-efficacy is defined as people's belief in their ability to produce desired levels of performance, such as shifting from being sedentary to more active physically. Having a higher self-efficacy would influence them to engage in physical activities and give them high confidence in their abilities to keep doing it. On the contrary, people with low self-efficacy most likely will doubt their abilities and stay away from the tasks they saw as personal threats, had low aspirations and a weak commitment to the goals they chose to pursue. In addition, they also laid back their efforts and gave up quickly in the face of difficulties (Weibell, 2011).

Song et al. (2013) state that the lack of physical activity and consumption of an unhealthy diet were the two primary contributing factors to obesity and weight problems. Song et al. (2013) argue that the lack of physical activity and the consumption of an unhealthful diet were the two primary factors contributing to obesity and weight problems. Less than 30 per cent of U.S. adults aged 18 years and older engage in regular leisure-time physical activity. The most significant barriers for obese people were their perception of body image and their laziness in exercise. It has been found that feeling too fat to exercise is a common barrier to overweight, especially women. Women had significantly lower self-efficacy exercise than men with a mirrored condition—women who may be more sensitive to body image than any other population. Women are generally more likely to have higher self-awareness and body image dissatisfaction than men (Song et al. 2013).

Self-efficiency expectations were the individual's belief in his/her ability to carry out the necessary courses of action to meet situational needs, and he/she was theorized to influence the activities that individuals choose to engage in, the effort made to carry out such activities, and the degree of persistence demonstrated in the face of failure or aversive stimulus. Perceptions of personal efficacy have typically been identified as important predictors of physical activity (such as exercise) and other health outcomes (McAuley and Bryan, 2000). In addition, according to Vernadakis et al. (2014), the motivational factors contributing to a healthy lifestyle have been a key component in identifying appropriate intervention, particularly in improving physical activity among young adults.

Expectancy value theory

According to McGregor (2010), the expectancy-value theory had been applied to several different settings, including sport. It was used to investigate the relationship between self-confidence and task beliefs with activity choices and participation behaviours. Two key determinants directly influence the choices and behaviours of achievement: the expectancies of success and the subjective task value. Expectancies of success refer to a person's competence beliefs in a particular achievement domain, while subjective task value refers to the importance that the person places on being successful in an achievement domain.

There were four components that make up subjective task values which were attainment value, intrinsic value, utility value, and cost (Vernadakis et al., 2014). Firstly, the attainment value was the importance a person places on being successful in that particular achievement domain. The intrinsic value was the interest or enjoyment one receives from participating in the task. Utility value was the usefulness of the task for future and current goals, and lastly, the cost was what was lost or sacrificed for participating in the task.

Potential of exergame in physical activity sustenance

According to Lisbeth (2013), exergames have been suggested as an innovative approach to improving physical activity. Exergaming aims to overcome some of the reported perceived barriers to physical activity among young adults. There were two types of potential barriers: internal barriers and external barriers—the internal barriers comprising of the lack of energy, lack of motivation, and lack of self-efficacy. Whilst external barriers reported were the lack of money, lack of social support and lack of time (Arzu et al., 2006; Hoare et al., 2017). Exergame provides a more attractive mode of physical activity and ability to engage audiences across different age groups. They are usually self-paced and ranked according to the ability of the player, which, in a way, enhances their motivation to complete a physical activity and undermines the poor health barrier.

Exergames could be a convenient tool that allows supervised activities, despite geographical distances, to provide physical activity in the familiar home environment, thus overcoming difficulties for those with limited mobility (Lisbeth, 2013). According to Carminda (2013), the use of serious games for rehabilitation, health promotion, physical fitness and health surveillance could be of relevance to overweight or obese individuals who require nutritional education or physical rehabilitation through game-related motor skills training and health indicators assessment and analysis.

In addition, McGregor (2010), suggested that health-based practitioners should increase the amount of time spent by students in moderate to vigorous physical activity to the best of their circumstances and also expose students to as many health-promoting activities as possible. They could also empower students with the information they could use to conduct health-promoting behaviours outside the classroom. Also, gaming systems provide players with the opportunity to play games actively, requiring either part or body movement. Therefore, compared to traditional sedentary-style games, it seems plausible that there may be benefits in encouraging young adults to play action video games also known as exergame, aiming at increasing daily energy expenditure (Vernadakis et al., 2014).

Besides, low self – efficacy towards exercise was seen among young adult (Pajares, 2005). Many studies have shown that young adults have less interest and low self-efficacy in performing physical activities that will affect their health status. Some young adults were physically active, and some of them were sedentary. Most young adults experienced some physical activity difficulties due to certain factors, including body image concerns. In addition, the importance of the expectancy-beliefs and task values of specific domains within the physical activity setting led some researchers to use the expectancy-value model to investigate the effectiveness of different approaches to increasing the level of physical activity of young adults (Mcgregor, 2010).

Data and Methods

Participant

This behavioural intervention study was conducted among Health Science undergraduates in Kota Bharu, Malaysia (N=102; 51 males, 51 females) to assess the potential influence of exergaming on self-efficacy in sustaining physical activity. We also compare the ability-expectancy and subjective task values to the physical activity by gender. Only those who practice a sedentary lifestyle based on GPAQ and report no medical conditions have been included in this study. The sample size required was determined using the Raosoft sample size calculator (Raosoft, 2004). The required sample size calculated was 102, taking into account the 10% of possible dropout, the undergraduate population size (N=2600), the target response rate of 50 percent and the confidence level set at 95 percent. The participants who met the inclusion criteria (1. Being a local undergraduate student; 2. healthy with no serious health problem; 3. Sedentary) were sampled using a systematic random sampling method. The participants were assigned to play the *Your Shape Fitness Evolved* exergame (Ubisoft, 2012) for a duration of 40 minutes using Microsoft Xbox 360 game console with the Kinect sensor. The participants completed a set of questionnaires before and after the exergame play. Informed consent was obtained from each participant prior to involvement in this study. The intervention was carried out in a controlled environment (at the Sport Laboratory).

Global physical activity questionnaire (GPAQ)

The Global Physical Activity Questionnaire (GPAQ) was used to screen the level of physical activity (PA) of the potential participants, either sedentary or active as part of the inclusion criteria. GPAQ collects information on PA participation in three settings – PA at work, travel to and from places and recreational activities as well as sedentary behaviour. The questionnaire consists of 16 questions covering both vigorous and moderate-intensity PA. The participants were, for example, asked how much time they spent doing vigorous-intensity activities at work on a typical day or week, on how many days they walk or cycle for at least 10 minutes continuously to get to and from places. For the purpose of screening, sedentary participants were characterized as those who fall under low level of PA, which reported less than 30 minutes spent on daily physical activity of moderate intensity.

Exercise self-efficacy scale (EXSE)

The Exercise Self-efficacy Scale (EXSE*)* designed by McAuley, Lox and Duncan (1993) was used to assess the participants' beliefs in their ability to continue exercising on a three-time per week basis at moderate intensities for at least 40 minutes per session in the future. For each item, participants indicate their confidence to execute the behaviour on a 100-point percentage scale comprised of 10-point increments, ranging from 0% (not at all confident) to 100% (highly confident). Total strength for each measure of self-efficacy is then calculated by summing the confidence ratings and dividing by the total number of items in the scale, resulting in a maximum possible efficacy score of 100.

Expectancy-related beliefs and task value questionnaire

The questionnaire originally developed by Eccles et al. (1983) and was modified by Xiang et al. (2003) to address the domain-specific questions for Physical Exercise (PE) and Exergames. All items were answered using a 5-point Likert-type scale. There are two sections. The first section of the survey included questions relative with the participants' demographic information, such as age, gender and academic year. Subsequent sections measured beliefs about ability, expectancies for success, components of value (importance, interest, usefulness), and intention for future participation. For the beliefs about ability section, participants rated their general ability in PE and exergame by responding to three questions. In the expectancies for success section, two questions were used to assess expectancies. Furthermore, in the components of value section, two questions addressed the component of attainment value or importance, two questions assessed the component of intrinsic or interest value and once again, two questions were used to assess the component of utility value or usefulness. Finally, in the intention for future participation section, a single item was used to measure participants' intention to engage in PE and exergames in the future.

Data analyses

Data were analyzed using SPSS version 22. Normality of distribution was tested with the Shapiro Wilk test. The means of expectancy-related beliefs, task values, and intentions of male and female participants were

analyzed using Independent Sample T-Test. The self-efficacy of participants before and after exergames was analyzed using Paired Sample T-Test.

Results and Discussion

Finally, out of 150 eligible students screened, 102 was found as sedentary. The categorization was done according to the following criteria:

High: A person reaching any of the following criteria are classified in this category. Vigorous-intensity activity on at least three days achieving a minimum of 1500 MET-minutes per week or seven or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of 3000 MET-minutes per week.

Moderate: A person not meeting the criteria for the 'high' category, but meeting any of the following criteria is classified in this category. Three or more days of vigorous-intensity activity of at least 20 minutes per day or five or more days of moderate-intensity activity or walking for at least 30 minutes per day or five or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of 600 MET-minutes per week.

Low: A person not meeting any of the above-mentioned criteria falls in this category. *Sedentary behaviour* was classified according to minutes per day of sitting at a desk, sitting with friends, travelling by car, bus, train, reading, playing cards or watching television, excluding the time spent for sleeping.

The sociodemographic profile of the study participants was illustrated (see Table 1). The participants mostly Malay (95%) and a small proportion of Chinese (5%) students. The mean age of males and females were 21.2 ± 1.76) and 22.6 ± 1.22 respectively. Majority had normal BMI (61.8%, n = 63), followed by underweight 17.6% (n = 18) and overweight 11.8% (n = 12), and only 8.8% (n = 9) were obese.

Table 1. Sociodemographic profile of the study participants

Variable	Gender N (%)		Total
	Male	Female	102 (100)
Ethnicity			
Malay	51 (50)	45 (44.2)	96 (95)
Chinese	0 (0)	6 (5.8)	6 (5)
Age			
Mean (SD)	21.2 (1.76)	22.6 (1.22)	
Median (IQR)	21.0 (2)	23.0 (1)	
Age Range (year)	19 – 26	21 – 28	
Body Mass Index			
Underweight	10 (9.8)	8 (7.8)	18 (17.6)
Normal	30 (29.4)	33 (32.4)	63 (61.8)
Overweight	5 (4.9)	7 (6.9)	12 (11.8)
Obese	6 (5.9)	3 (2.9)	9 (8.8)

Comparison of self-efficacy of participants before and after exergames

There was a substantial improvement in self-efficacy after exergame play as compared to before exergame play (27.1 ± 4.33 vs 32.2 ± 4.5, $p < 0.001$) (see Table 2). This finding was in accordance with Song et al. (2011). Chao et al. (2013) reported a contradictory finding whereby no improvement in self-efficacy was noted among study participants after exergame play. The difference is most likely due to the difference in inclusion criteria set, whereby our study recruited only those who are sedentary. In addition, our finding showed that

exergame could be used to motivate students to continue to engage in exercise. The premise of the new generation of active video games was that they could reach the sedentary population in order to provide a fun way to motivate them to engage in physical activity. In addition, it was likely that the projected image of the player on the screen could successfully include empirical evidence that self-awareness of the players could be induced by looking at their own image like on exergames. Encouraging young adults to exercise over time could be difficult. Boredom was one of the possible reasons for them to stop practicing, but the result reported was a very enjoyable experience and expressed a desire to continue practicing. In addition, exergame could be considered as a safe exercise tool since none of the participants suffered falls or injuries during exercise sessions. These results support the exergame as a promising intervention to improve self-efficiency among students in order to strengthen the level of confidence of the individual to exercise.

Table 2. Comparison of self-efficacy of participants before and after exergame play

Variables	Exergame		Mean of score difference (95% CI)	t-stats (df)	p-value
	Before Mean (SD)	After Mean (SD)			
Self - efficacy	27.10 (4.33)	32.17 (4.51)	-5.07 (-5.95, -4.19)	-11.41 (101)	< 0.001

Comparison of the expectancy-related beliefs, task values and intentions between gender

The related result was shown (see Table 3). There was a significantly firmer belief in the ability of males (p-value < 0.001) than females with a mean difference of 0.84 scores (95 percent CI of mean difference: 0.12, 1.57). Other than that, all other components of expectancy-related beliefs, task values, and intentions were not significantly gender-specific. These findings suggested that both male and female participants' in this study shared similar expectancy for success, attainment value, interest, utility and intention for future participation as regards to exergame play. Conversely, the previous McGregor (2010) study showed that boys tend to have lower expectations of success in exergames, while girls' expectations tend to be more stable across types of activities. Also, the value of girls' interest was higher than that of boys in exergames, where girls would have a higher intention of using exergames in the future. Song et al. (2011) suggest that women were generally more likely to have higher self-awareness than men. However, our findings were similar to those of Gao et al. (2009) who reported no significant differences in average expectations of beliefs, task values, self-efficacy, and gender-wise outcomes (Gao et al. 2009). The result showed that gender had no direct effect on the emotional reactions to the exergame play, nor did it affect the willingness of the player to continue playing.

Variable	Means (SD)		Means diff (95% CI)	t statistic (df)	P-value
	Male (n=51)	Female (n=51)			
Belief About Ability	9.02 (1.74)	8.18 (1.94)	0.84 (0.12,1.57)	2.32 (100)	0.02
Expectancy for success	7.75 (1.31)	7.59 (1.34)	0.16 (-0.36,0.68)	0.60 (100)	0.55
Attainment value	7.71 (1.21)	7.47 (1.58)	0.24 (-0.32,0.79)	0.85 (100)	0.40
Interest Value	8.76 (1.24)	8.75 (1.41)	0.02 (-0.50,0.54)	0.07 (100)	0.94
Utility Value	7.92 (1.18)	8.24 (1.45)	-0.31 (-0.84,0.21)	-1.19 (100)	0.23
Intention for future participation	8.41 (1.30)	8.57 (1.42)	-0.16 (-0.69,0.38)	-0.58 (100)	0.56

Table 3. Comparison of the expectancy-related beliefs, task values and intentions for future participation between gender.

Conclusion

This study provided some preliminary evidence of the influence of exergame play on improving self-efficacy towards physical activity among young adults. This will help them to achieve the physical activity recommendation and stay active. Being physically active will contribute to a healthier lifestyle in our community, reduce the risk of health problems such as cardiovascular disease and improve the quality of life. Based on our experience and observation, many university students have not yet known the existence of such a video game, which is also a form of exercise or exercise until they have participated in this research. In order to encourage these youngsters to exercise and prevent sedentary lifestyles on campus, more awareness-raising campaigns on the benefits of exergames should therefore be undertaken by the authorities and higher learning institutions (HLI). This study clearly shows that exergame is a more attractive, attractive and joyful alternative to conventional physical activity or exercise, mostly for younger generations. It is therefore highly recommended that the HLI provide exergaming facilities to students. While it has been widely used in developed countries to improve health and physical education in schools, it is still new in Malaysia, calling on related authorities, such as the Ministry of Health and the Ministry of Education, to explore the feasibility and cost-effectiveness of exergame use in that country. In addition, it is good to have our own local exergame version specifically tailored to the population of Malaysia. This study may therefore propose that any enthusiastic researcher and expert in Malaysia initiate an effort to develop and invent such an exergame.

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