USING TEAM SUPPORTS AND GAMIFIED WEB-BASED APPROACHES TO ATTAIN RECOMMENDED LEVELS OF PHYSICAL ACTIVITY AMONG INTERNATIONAL INDONESIAN STUDENTS

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ABSTRACT

Introduction*: The interactive web-based, blended with tri-axial accelerometer by smartphone Apps, have the potential to help university students adopt and maintain a physically active lifestyle.The purposes of this text was to evaluated a gamification base for International Indonesia students to determine the impacts of a program building with psychosocial base to increase the exercise efficacy to attain a recommended level of physical activity.* ***Methods****: A non-equivalent control group with pre and posttest design conducted in 86-Indonesian international students with a time cluster randomize to avoid information contamination between groups. The intervention group received a Social Cognitive Theory skill-building by web-based game with team competition for 10-week program. Outcomes include physical activity, health outcomes, and cardiopulmonary fitness. ANCOVA and McNemar X^2 test was adopted to test pre- and post-outcome effects.* ***Results:*** *The intervention group recorded more steps/day than those in the control (p <0.001, eta = 0.522), more distance (p <0.001, eta = 0.521), greater calories consumption (p <0.001, eta = 0.419), more longer (time) (p <0.001, eta = 0.217), more physical fitness (p <0.001, eta = 0.168), lower body weight (p <0.002, eta = 0.131), lower BMI (p <0.001, eta = 0.149), and lower systolic blood pressure (p <0.007, eta = 0.103).* ***Conclusions:*** *Web-based game with group competition programs can successfully increase physical activity among international university students.The results could serve as a good approach for health professionals to design an effective program toachieve recommended levels of physical activity and the physical fitness.*

Keywords*: physical activity, outcome expectancy,self-efficacy, university students, web-based*

INTRODUCTION

Insufficient physical activity is one of the 10 leading risk factors for global mortality (WHO, 2018). People who are insufficiently physical activity have ranged from 6% to 10% increased risk of mortality cause contributing form non-communicable disease compared to those who engage in at least 150 minutes of moderate intensity physical activity per week, or equivalent (Lee, et al., 2012). According to a worldwide survey for prevalence of physical inactivity across 23 countries among university students, the study results show that the overall prevalent rate of low intensity levels of physical activity was 41.4% (Pengpid et al., 2015).Particularly with regard to international students' physical activity involvement, participation rates also tend to be low (Kenya, Brodsky, Divale, Allegrante, &Fullilove, 2003). To design an effective program is very important for promoting physical activity among university students.

To promote physical activity behaviors for university students are required and essential and to support long-lasting behaviors change beyond late adulthood (Dumith, Hallal, Reis, & Kohl III, 2011). However, the determinants and antecedents of physical activity are diverse, thus increasing physical activity is a societal, not just an individual problem for school-base population (Alsubaie& Omer, 2015). Therefore, the strategies are applied basing on university students' preferences and it is better to merge in their daily activities such as electronic technologies usages by Internets and smartphones (Alfawareh, &Jusoh, 2014).

Internet-based approaches, social aspects and having fun may be important in promoting health and physical activity among young people (Rees et al., 2006). Up-to-date interventions utilize new opportunities like's web-based technologies becoming popular and widely adopted, and overcome limitations for plenty of time and economic costs leading to fatigued participations in the traditional approaches in promoting physical activity (Pagliari et al., 2005; Marcus et al., 2006). Web-based physical activity interventions

represent a potential high-reach, low-cost method to promote physical activity (Marcus et al., 2006) and have shown promise in past studies with predominantly university students (Grim, Hortz, & Petosa, 2011; Joseph et al., 2013; Hargreaves, Mutrie, & Fleming, 2016; McIntosh, Jay, Hadden, & Whittaker, 2017). However, little is known about the effectiveness of these approaches among international students.

It was suggested if research on specific intervention elements were needed to understand how best to use websites and other Internet-related communication technologies as delivery methods for physical activity interventions (Vandelanotte, et al., 2007). Joseph et al. (2013) recommend future directions, for internet-based physical activity interventions incorporate emerging mobile technologies (ie, cellular and Smartphones) into Internet-based physical activity efforts. Therefore, more knowledge is needed to explore the influence of digital physical activity promotion and the interactive technologies on self-rated health or overall wellbeing.

In recent years, games have found a new application, as the era of gamification has been launched. Gamification is an emerging field and has shown to be promising, achieving its effectiveness by rewarding, social bonding, and making the health intervention fun to engage in (Cugelman, 2013; Göbel, Hardy, Wendel, Mehm, & Steinmetz, 2010; Staiano& Calvert, 2011). Regarding the physical activity outcome, it was evaluated by pedometers to count walking-step for the previous three studies. Yet, basic gamification mechanisms such as competitions and challenges have been relatively poor evidences to examine the effects of increasing physical activity, especially for attaining a recommended level among university students.The purpose of this study was focused on increasing levels of physical activity and the calories consumption related to physical activity, health outcomes, and cardiopulmonary fitness.

METHODS

Design and Sample

The nonequivalence control group design was conducted. The study was a 10-week 1:1 time-cluster randomization of the intervention group versus a control group among international students. A time cluster randomize design was used to minimize between group contaminations by having the two groups (intervention and comparison) from a university for related information. Interested subjects were invited from the international office affair or international-student unions of a National University in southern Taiwan.

Eighty Indonesian international students who are aged with 20 years or above, willing to participate, readable in English, smartphone with Internet access, and did not participate others' PA or fitness training program during the current study period were allowed to register for WGTC. Ten students were excluded because of not eligible, sick and drop out from study.

Data from 70 students (intervention group, n = 34; control group, n = 36) who responded to all our scheduled inquiries during the intervention were analyzed. All participants were assessed at 2-time points: the baseline at entry and after 10-week of intervention. The present study was approved bythe Ethics Committee of the university hospital.

Intervention program

A Web-based game with team competition (WGTC) on web was used to promote international students level of PA in the intervention group. The performances of PA on both individuals and groups were showed in the WGTC of web page that the information is automatically provided by the iNCKU watches and the smartphone Apps through daily use. And then using those data play a social game.

First, the researchers were explained purposes of this study and give a booklet for providing PA related knowledge.Self-administrated structured questionnaires were used to collect data within 30 minutes that include social demographics, self-efficacy (SE) exercise and the outcome-expectation (OE) of PA, a 3-minute step test to assess cardiopulmonary fitness, height, weight, blood pressure and levels of PA by watch sensor for 7 days.

After pretest, the intervention group was additionally received one-50 minutes'

instruction according to a guideline for learning to use the watches sensor to collect the PA and transmitting the PA information to smartphone Apps and WGTC program for implementing competition game during 10 weeks. Regarding ethics issues, the ID and password was set by users through the smartphone App to review individual PA information on the web-page. For game competitions, 11 teams were created in the intervention group and each team includes 3 or 4 members basing on the friendships.

Control conditions

Participants in the control group was received usual care.

Measures

The performance of PA was measured by a small tri-axial accelerometer, as a watch to wear on the unusual hand. The movement data transmitted through smartphone App via Bluetooth, automatically transform the movement signals 24 hours, including daily walking steps, distances, time durations, and energy consumptions for PA.

A 3-minute step test with a stool height of 30.5 cm was performed with cadence control by a metronome throughout the test period according to the YMCA Fitness Testing and Assessment manual (Golding, 2000). The sum of pulse counts was obtained from the metronome recording 1 to 1.5, 2 to 2.5, and 3 to 3.5 minutes after stopping the test to determine the pulse rate.

Physical anthropometrics including height and weight was measured by a valid electronic stadiometer. Blood pressure was measured by a registered nurse using a validated and calibrated digital automated sphygmomanometer, after the participant had rested for at least 15 minutes (El Assaad, Topouchian, Darne, & Asmar, 2002). Two consecutive measurements were obtained 5-minutes apart and the average of the two readings was recorded (Pickering et al., 2005).

Data Analysis

Demographic characteristics and baseline measures were compared at baseline using Pearson chi-square tests, and independent samples t-tests. Change from pretest to posttest in outcome variables were calculated.

Four multivariate ANCOVAs, with the baseline scores as the covariate, was used to measure differences in self-efficacy, outcome expectancy value, and cardiopulmonary fitness between the groups at 10 weeks. All statistical analyses were carried out using SPSS version 17 (IBM, Chicago, Illinois). All tests were conduct with the α-level at 0.05, if ρ-value ≤ 0.05 consider statistically significant in the data analysis.

RESULTS

1. Descriptive Statistics

1.1. Attrition

The sample consisted of 75 international students at pretest who were randomly assigned to either the intervention or control group. Figure 1 shows the flow of participants in the program, including the number of participants, the grouping, and the program flow over time. Five participants (15%) were excluded from the final analyses because they did not return for post testing, 2 in the control group and 3 in the intervention group, leaving a final sample of 70 with 34 in the intervention group and 36 in control group. A non-significant chi-square test showed these rates of attrition to be equivalent across groups, $\chi 2 = 1.71$, P=0.19. In addition, 2 x 2 Intervention by Dropout Status ANOVAs examining attrition bias revealed only one significant main effect or interaction involving differences between dropouts and non-dropouts across 13 independent statistical tests. Indeed, using a liberal $\alpha = 0.05$, the only significant effect was an attrition by treatment-group interaction for outcome expectation, $F(1,67) = 2.16$, P=0.027. Because of the general lack of main effects or interactions, and the liberal alpha applied to these tests, they were not examined further.

1.2 Demographics

Baseline characteristics for all study participants are provided in Table 1. The mean age of the participants was 25.8 years, ranging from 22 to 48 years, and 75% received master program. The average weight, and BMI of participants in each group were about 62.4 kg, and 23.2 kg/m^2, respectively. The majority of participants were never smoking (n = 64, 88%), no history of hypertension (n = 65, 90.3%), and no family history (n = 62, 86.1%).

There were no significant differences between the intervention and control groups on any of the demographic, physical activity, physical fitness, or SCT variables at pretest (all p >0.05, see Table 1 for means and standard deviations). On average, 90%-95% of participants accessed to website, recorded physical activity, and set physical activity goals each week, and, 85% increase physical activity. The attrition rate was about 21% for the intervention groups and 18% for the control groups.

Table 1. Demographic Characteristics Overall and by Experimental Condition (N= 70)

	Overall Mean (SD)/%	**Intervention (n = 34) Mean (SD)/%**	**Control (n = 36) Mean (SD)/%**	**F or χ^2**
Age	25.86(4.33)	26.88 (5.69)	24.89 (2.12)	0.54
Gender (male)	54.3%	58.8%	50.0%	0.31
Education (master degree)	91.4%	91.2%	91.7%	0.64
Religion (Islam)	58.6%	50.0%	66.7%	0.50
Smoking (Never smoking)	88.6%	85.3%	91.7%	0.69
PA Habit (No)	68.6%	67.6%	69.4%	0.54
DM History (No)	97.1%	94.1%	100%	0.14
Hypertension History (No)	90%	91.2%	88.9%	0.75

1.3 At the End of the Intervention

A series of 2 (intervention or control) between-groups ANOVA tests showed no significant pretest effect for steps/day, distance, calories consumption, time/minutes, body weight, BMI, systolic blood pressure, physical fitness, SE, SS, and OE (all p >0.05). Therefore, pretest sensitization did not occur for any of the outcome measures (see Tables 2-3 for descriptive statistics).

The main effects of the intervention on steps/day, distance, calories consumption, time/minutes, systolic blood pressure, and cardiopulmonary fitness were significant. The intervention group participants recorded more steps/day than those in the control (p <0.001, eta = 0.522), more distance (p <0.001, eta = 0.521), greater calories consumption (p <0.001, eta = 0.419), more longer (time) (p <0.001, eta = 0.217), more cardiopulmonary fitness (p <0.001, eta = 0.168), lower body weight (p <0.002, eta = 0.131), lower BMI (p <0.001, eta = 0.149), and lower systolic blood pressure (p <0.007, eta = 0.103). No main effect of the intervention was observed for body weight (p >0.05, eta = 0.031), and BMI (p >0.05, eta = 0.049). For the SCT constructs, significant main effects of the intervention were found for social support (p <0.001, eta = 0.229), with participants in the intervention groups reporting higher social support than those in the control groups. No main effect of the intervention was observed for self-efficacy (p >0.05, eta = 0.041), and outcome expectation (p >0.05, eta = 0.046).

Table 2. Descriptive Statistics for Main Study Outcome Variables at Pre and Post Test (N= 70)

Variables	**Mean (SD)**	
	Pre test	Post test
Physical activity		
Steps	3589.14 (2637.72)	6295.74 (2656.17)
Distance	2.51 (1.85)	4.44 (1.82)
MET	127.21 (93.88)	198.57 (83.70)
Time	33.16 (22.61)	64.07 (42.16)
SCT Constructs		
Self-efficacy	80.56 (29.98)	83.26 (31.67)
Social support	33.51(12.19)	36.49 (10.15)
Outcome expectation	32.10 (6.24)	31.29 (4.73
Health outcomes		
Body weight	62.36(11.15)	61.69(11.30)
BMI	23.25(3.05)	23.00 (3.07)

Systolic blood pressure	119.39(11.58)	115.14 (10.47)
Physical fitness	52.31 (6.19)	57.88 (7.10)

Table 3 Results of Physical Activity, Health outcomes and SCT Variables for the Expected Treatment Group by Time Interaction (N=70)

	Intervention with Pretest		Control with Pretest		df	F	P
	Pretest	**End of intervention**	**Pretest**	**End of intervention**			
Physical activity							
Steps	2689.80 ± 4547.49	7757.99 ±8718.71	2663.98 ± 4458.58	3704.97 ± 5217.14	1.68	71.486	0.000
Distance	1.88 ± 3.18	5.43 ± 6.10	1.86 ± 3.12	2.66 ± 3.70	1.68	70.445	0.000
MET	95.20 ± 161.33	234.22 ± 271.25	94.29 ± 158. 16	122.07 ± 172.77	1.68	45.573	0.000
Time	25.44 ± 41.39	68.70 ± 98.60	25.24 ± 40.60	34.62 ± 56.55	1.68	17.701	0.000
SCT Variables							
SE	75.25 ± 94.45	79.95 ± 100.82	65.67 ± 87.33	65.62 ± 87.43	1.68	3.47	0.067
SS	28.40 ± 36.19	37.33 ± 44.84	30.22 ± 39.11	29.65 ± 34.62	1.68	16.686	0.000
OE	30.37 ± 34.10	31.15 ± 33.50	29.58 ± 34.36	28.41 ± 32.20	1.68	3.291	0.074
Health outcomes							
BW	59.04 ± 65.44	57.78 ± 64.30	58.11 ± 66.83	57.92 ± 66.70	1.68	0.218	0.642
BMI	22.33 ± 24.10	21.84 ± 23.62	22.10 ± 24.47	22.05 ± 24.42	1.68	0.468	0.496
SBP	115.85 ± 123.33	109.02 ± 115.91	114.97 ± 123.42	114.11 ± 121.23	1.68	4.529	0.037
Physical fitness	49.34 ± 53.02	57.72 ± 62.28	51.06 ± 55.70	53.46 ± 58.29	1.68	6.357	0.014

DISCUSSIONS

This is the first reported study using the Web-based gamification combine with group competition as a tool to promote physical activity in Indonesia, and in particular, with Indonesia international students. Overall, the intervention was successful with large effect sizes. The SCT-based Internet intervention and group competition program was effective in promoting and maintaining physical activity in Indonesia international students. The intervention had significant effects on steps/day, distance, calories consumption, time, and SCT variables at the end of the intervention. Though the intervention successfully improved physical fitness at the end of the intervention. This study used a true intention-to-treat analysis such that data on all participants randomly allocated to the intervention and the control groups were analyzed. Demographic data and dependent variables at the baseline were not significantly different between participants who completed the study.

1. Effects on Physical Activity and SCT Variables

The success of the intervention in changing behavior and SCT variables is consistent with previous studies with female university students (Wadsworth, & Hallam, 2010; Huang, Hung, Chang, & Chang, 2009), and with review and meta-analysis studies that have reported the efficacy of Internet-based interventions in promoting physical activity (Vandelanotte, Spathonis, Eakin, & Owen, 2007; Norman, Zabinski, Adams, Rosenberg, Yaroch, & Atienza, 2007; Marcus, Ciccolo, &Sciamanna, 2008; Davies, Spence, Vandelanotte, Caperchione, & Mummery, 2012). However, those reviews and meta-analyses reported small effect sizes, (Vandelanotte, Spathonis, Eakin, & Owen,

2007; Norman, et al., 2007; Davies et al., 2012) whereas this study found large effect sizes. Thus, a SCT-based Internet intervention is a useful tool in the promotion physical activity in Indonesian international students. Of note, this study found that steps/day of participants in the control group remained at the low-end of steps recommendations (i.e., < 7500) (Tudor-Locke, Craig, Thyfault, & Spence, 2012).

However, participants in this study were not contacted or did not have access to interactive features after intervention period. Marcus et al., (2000) suggest that the lack of contact with participants during follow-up might play role in physical activity relapse. Thus, the physical activity relapse in previous studies may be because most Web-based programs are not interactive enough during the follow-up period to engage participants fully (Carr, Bartee, Dorozynski, Broomfield, Smith, & Smith, 2008). Future studies should examine the influence of continued contact or website access post-intervention on the maintenance of physical activity.

This research highlights possible cross-cultural considerations of using SCT and the Internet to promote physical activity. The influence of Indonesia culture may explain some of the maintenance of physical activity during intervention period. Cultural background and experiences can influence the self; moreover, the way that people live, think, and behave are influenced by culture (Markus, &Kitayama, 1991; Lim, Waters, Froelicher, &Kayser-Jones, 2008). People in Western countries are more likely to be independent (behavior is organized primarily by reference to one's own thoughts, feelings, and actions) whereas people in Asian countries are more likely to be interdependent (behavior is determined by the perceived thoughts, feelings, and actions of others) (Markus, &Kitayama, 1991). The interdependent self of Indonesia students may have influenced to promote physical activity, an idea corroborated by the low attrition rate (~21%) in this study compared to previous Western studies (~30%) Vandelanotte, Spathonis, Eakin, & Owen, 2007; Davies et al., 2012). It is also possible that the relationship between the self and SCT variables in Indonesia students may be stronger than for Western students.

According to Bandura (1997), SCT operates at interpersonal levels. SCT assumes humans are social beings who develop their sense of self and personal efficacy from others through interpersonal exchanges, and that the interpersonal environment is critical in affecting and predicting one's health behavior and, in turn, health outcomes. Therefore, the interdependent self in Indonesia students may have a stronger influence on SCT variables than for Western students who may be more independent. However, the influence of culture on starting and maintaining physical activity was not examined in this study; thus, this suggestion needs verification and future studies should examine the specific influence of culture on the efficacy of SCT-based physical activity programs.

2. Effects on cardiopulmonary fitness

Despite changes in physical activity and SCT variables, the intervention had effect on physical fitness. Physical fitness was increased at the end of the intervention. It is known that physical activity participation is one important factor for determining cardiovascular fitness (Wadsworth, D. D., & Hallam, J. S, 2010) and many studies report a significant correlation between physical activity level and cardiovascular fitness (World Health Organization, 2018; Wong, F. Y., 2017). However, this association is stronger for higher intensity physical activity. Participants in the current study could participate in the physical activity of their own choosing and were asked to increase duration of physical activity by 30 minutes per week (Zhao, C.-M., Kuh, G. D., &Carini, R. M., 2005). Although, participants met our recommendations, it is likely that the physical activity may not have been of sufficient intensity to improve cardiovascular fitness. However, the increase in physical activity may still have influenced health outcomes, particularly in the area of metabolic fitness, an area for future research (Zhao, C.-M., Kuh, G. D., &Carini, R. M., 2005).

Further work is required to determine how to maintain physical activity behavior in the longer term. Fjeldsoe and colleagues' (2011) review of physical activity behavior change maintenance suggests that increasing the intervention's duration, and/or building long-term follow-up prompts into the app may be useful in achieving this. While the study's

intervention was mainly guided by the theory of planned behavior, other behavior change theories which emphasize behavior maintenance, such as the transtheoretical model (Prochaska &Velicer, 1997) or the Health Action Process Approach (Luszczynska, 2008), and self-regulation theories (Maes&Karoly, 2005) may provide valuable insights into further strategies to maintain behavior change in the longer term.

Gamification has been a popular tech trend in recent years. The web-based game with group competition was carefully designed to incorporate numerous gamification features; however, usage statistics and participant feedback specific to these features suggested they were not strongly embraced by participants. Despite this, the web-based game overall achieved strong usage and participant feedback. It is possible that the influence of gamification was larger than participants indicated—that it worked in a subconscious way and did, in fact, contribute to engagement and utility of the web-based game.

Alternatively, it may be that gamification has been overhyped, or at least unsuccessful in the form in which it was implemented in our web-based game program. Such hypotheses cannot be answered by our study; indeed, the field of gamification for health behavior change is in its infancy and considerable further work is needed to explore its efficacy and optimal application.

This study has some significant methodological and theoretical strengths including the use of a randomized assignment with time cluster random design, and SCT and intervention mapping in developing the interactive intervention program. However, the research was limited to Indonesian international university students who may be more likely to have access to the Internet compared to other Indonesia populations. Thus, the results are not generalizable to other Indonesia population groups. Future studies should confirm these findings with other Indonesia population and include a measurement of the intensity of the activity undertaken.

CONCLUSIONS

In conclusion, SCT and web-based gamification combine with group competition intervention can be used as frameworks for developing physical activity interventions. A SCT-based Internet intervention program successfully promoted physical activity of Indonesia international university students, which is consistent with previous studies conducted in Western and Asian countries. The Internet is a potentially useful tool for delivering a SCT-based intervention physical activity program. However, the intervention should be tested in a variety of population over a longer period before wide scale implementation.

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